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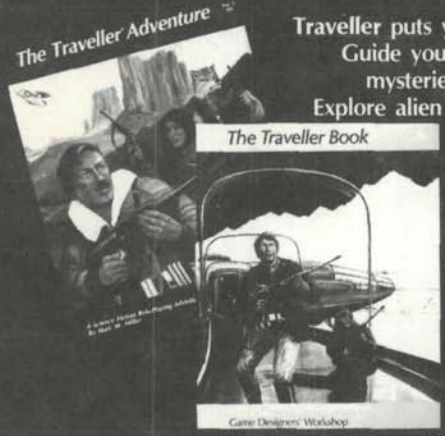

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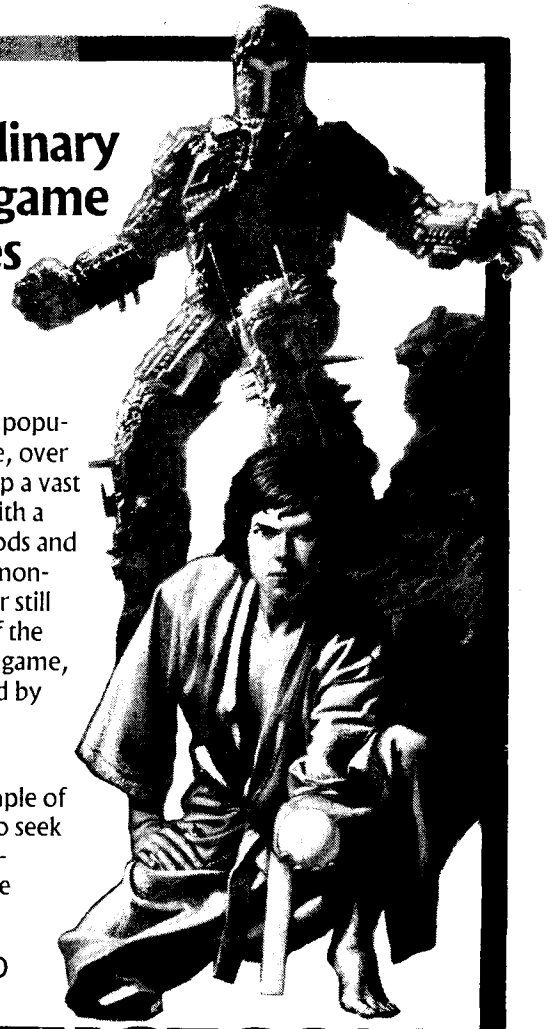

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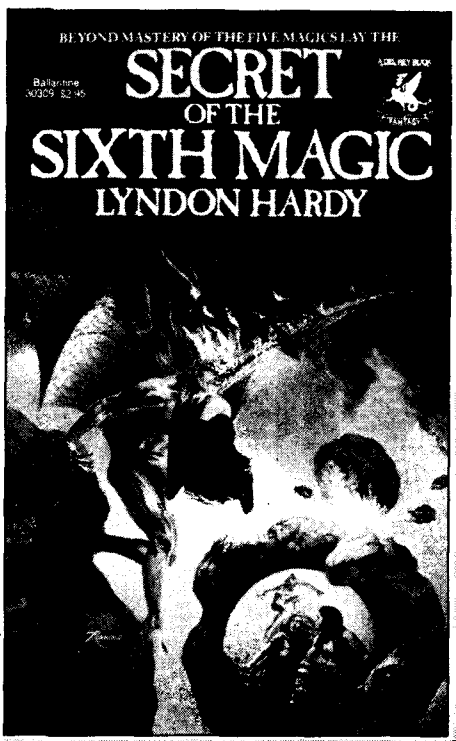

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Editorial

'TIS THE SEASON

Stanley Schmidt

You'll be reading this at a time when the U.S. political system is in fullest flower, when its mechanisms are operating in all their glory. You'll be able to tell by the seriocomic spectacle of party conventions and the intensity with which great numbers of politicians (and two or three in particular) seek to persuade you to vote for them.

Grade school teachers and some journalists call it "democracy in action," but that's not quite accurate in the original and strictest sense of the word. Pure democracy is direct rule by the populace, in which, as Alfred Edward Taylor put it, "no attempt is made to connect political power with any special qualifications." In the American version, everyday political power is vested in a small group of men and women, and the role of "the people" is to choose (more or less) those governing individuals. Theoretically, at least, they do try to choose the best qualified. But who *are* the best qualified? And why do candidates *want* you to vote for them?

Plato, well over two thousand years ago, had some interesting comments on both questions which are still worth pondering—and perhaps extrapolating a bit. Plato considered high moral character and wisdom prime requisites for

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rulers, and observed, in essence, that people who *want* power are the very ones who shouldn't be allowed to have it, while those who *should* hold office tend to avoid it like the plague. Probably even Plato would admit that this is a bit of an overgeneralization, but statistically it seems at least as valid as, say, contemporary weather forecasts.

Now, compare Plato's principles and precautions with American practice. In an election, the *only* choices we have available are people who are actively seeking power. Virtually all of them claim nobler motives, of course—in public they care only for the good of the nation, while in private they might echo other words of Plato by claiming they run only to avoid the dangers of being ruled by others less trustworthy. But the fact remains that the most visible fact about them is that they are trying very hard to gain or retain power, and the widespread cynicism about such people's historic performance did not become widespread without cause.

Could there be something in what Plato said? It's much too late to consider any basic changes for *this* election, of course, but the thick of the political fray seems an appropriate time to reflect on whether the existing system is truly optimal, and what other options might be possible. For example, might we at some time in the future carry Plato's logic a step further: disqualify anybody who actively seeks power for himself (psychological testing might even make it possible to identify those who are doing this surreptitiously), and draft our leaders from the well-qualified but reluctant? If Plato is right (and my observation of people both in and out of politics suggests that he is, at least frequently), the people who can do the best jobs will *have* to be drafted because they won't volunteer. And once they are in office, they cannot be motivated to do a good job by the desire to be re-elected, since they would rather be out than in. So we use *that* desire as both carrot and stick: we require them to earn their freedom! They must stay in office until they have accomplished some deed or deeds of public service which some suitable body judges valuable enough to deserve high reward—at which time they are permitted to return to civilian life. (What constitutes a "suitable body"—it might be anything from a full popular poll to a small committee assembled in any of a wide range of ways—is a procedural detail which I don't want to get into now. All I want to do here is throw the basic concept out for consideration.)

Since we won't be able to implement anything like this soon, even if everybody thinks it's a good idea (and when has everybody thought *anything* was a good idea?), we shall have to content ourselves with choosing carefully among the candidates on the ballot. But while doing so, it might be a good idea to bear in mind what one dominant characteristic they all have in common—which should make us at least slightly wary of anything else they may profess.

With that in mind, what other qualifications should we look for in political candidates? That's a big subject, and the answer depends at least somewhat on the job being sought. I don't plan to

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attempt a full and definite answer, but I would like to comment briefly on one aspect of the problem which seems to have been generally neglected.

If you look at the prior occupational background of congressmen, judges, and other high officeholders at just about any time in recent history, you'll find a large preponderance of lawyers. At first glance, this might seem perfectly reasonable—after all, they are dealing with the creation and carrying out of laws.

But the law is not—or should not be—an end in itself. It is a tool for regulating all the operations of the country—a means of keeping all the political, industrial, economic, and other interactions of its citizens with each other and with their environment, within reasonable bounds for the overall good of the nation and its inhabitants. Government is, in other words, the country-as-a-whole analog of the management of a corporation. Letting government consist mostly of lawyers is akin to letting a company be run entirely by people trained in business administration and nothing else. Yes, I know this is often (and increasingly) done—sometimes it even works, when individual managers have enough personal talent and initiative to overcome the handicap of a one-sided education—but I can't recommend it. In my experience, a very large percentage of the managers and administrators I could really respect were not "just managers," but *were themselves skilled practitioners of the work they were managing*. They could *do* the jobs they were supervising, and do them well, whether the work involved design, manufacturing, performing arts, or anything else.

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Now, it's true that we have a lot of lawyers in this country—a grossly disproportionate number, compared to other countries. But even the percentage of lawyers in the general population is nothing like that in government, and there are a great many other kinds of work which are of vital importance to the country's health. There are agriculture, shipping by land and sea and air, mining, forestry, education, all the health professions, entertainment, road maintenance, building construction, scientific research, engineering, law enforcement . . .

Etc., *etc.!*

If government is indeed the "overall manager" of all the country's business, shouldn't *somebody* in Washington—and I mean somebody in high places—know all those kinds of work from inside? Sure, a legislator or judge needs to know about law. But if he's going to legislate or adjudicate about education or trucking, shouldn't he also know what a classroom or a truck cab looks and feels like to the guy who makes his living in one?

We're not likely to find many individuals who can do that for many fields, unfortunately. There are too many different fields, and they've grown too big. But the next best thing might be a conscious effort to get people from a lot of those fields into government. Maybe we should consider "representation by occupation," as well as representation by domicile. I'm not suggesting that we need a system where we *have* to elect *m* farmers, *n* truck drivers, and so many each of coal miners, lumberjacks, kindergarten teachers, anesthesiologists, movie actors, ditchdiggers, electricians, astronauts, biochemists, beat patrolmen, and so on. (Although, come to think of it, I'm not sure I couldn't make as good a case for that as for our present purely geographical quotas. . . .)

I *am* suggesting that it's treacherous business to continue headlong into a complicated future trusting the supervision of highly sophisticated specialties to people who have no firsthand knowledge of the internal workings of those specialties. Eventually the problem may force some significant restructuring of government—but if enough people recognize it as a problem, it may be possible to begin making a dent in it now, under existing laws. Those who are active within political parties can work to seek out and promote candidates who are not "just lawyers," but also have a wide range of other expertise. All voters can encourage the nomination of such candidates by voting for diversity in the relatively rare cases when they are offered a real choice. Such feedback could encourage a trend, making such opportunities progressively less rare and government progressively more knowledgeable about the operations it governs. The upcoming election is none too soon to begin asking, of every candidate for every office, "What *else* can he do?" ■

● We don't inherit the earth from our ancestors, we borrow it from our children.

David Brower

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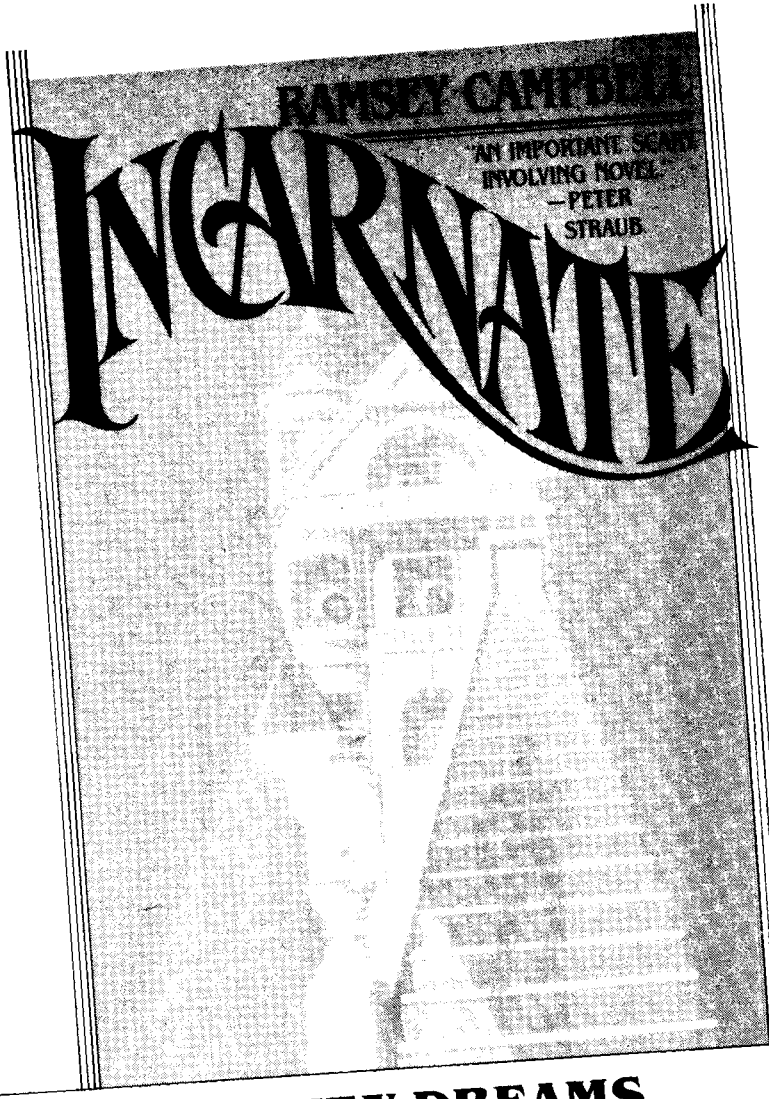

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RETURN TO THE FOLD

Timothy Zahn

If "sanity" means good adjustment to particular circumstances, it's a highly relative thing. But is it really that simple?

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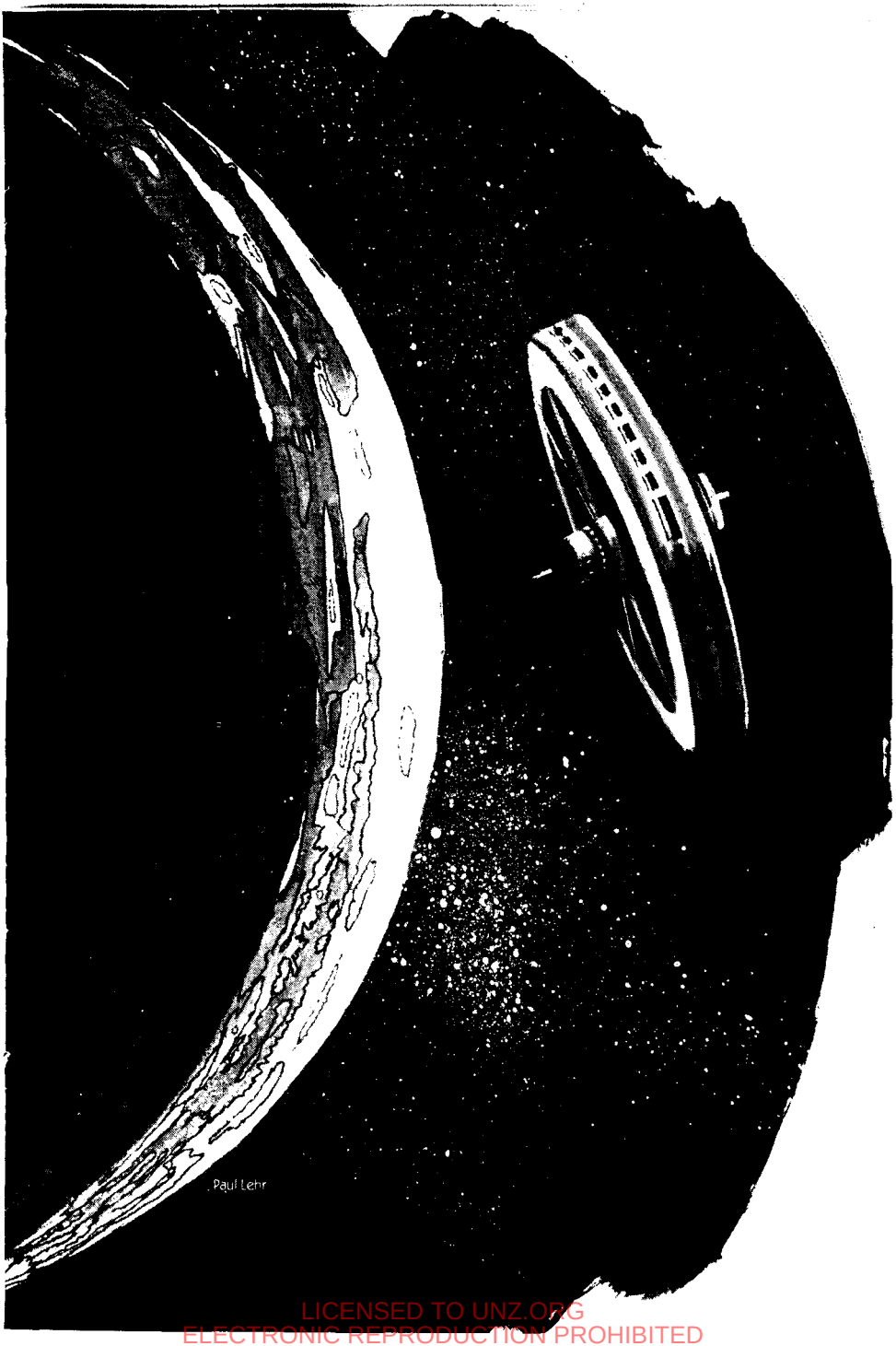

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The tiny spaceship was very definitely in trouble. Six enemy defiants were bearing down on it in a loose net pattern that Tomo knew was far more effective than it looked. Choosing one of the defiants at random, he kept his eye on it, control rod gripped tightly in his palm . . . and as the blue globe zigged he twisted the rod hard over, sending his spaceship into a zag maneuver that ran it neatly up against the defiant's side. Up against it at the required zero delta vee, in fact, and Tomo smiled briefly as the defiant vanished and his own ship grew another size. One down, five to go, with his craft now a bigger and slower target.

"Tomo?"

"What is it, Max?" Tomo answered, his eyes still on the images darting around above his lounge chair.

"I've located a fault in my number-five close-approach antenna," the computer told him. "Nothing serious; just a bearing shell that needs replacing."

"And you want it done *now*, I suppose?" He sighed, the gesture more theatrical than serious. Max always waited until they were only days out from a spaceport before checking the *Goldenrod*'s docking equipment, and the ship's six mainters were well used to it by now. In theory, it could result in a mad rush if something major went bad, but in practice the odds against that were low enough to ignore. "All right. Freeze the game and give me a schematic. Flat will do."

The holographic game images froze in midair and then vanished as Tomo levered himself easily out of his chair. The *Goldenrod* was decelerating at about two-tenths gee, half of what he was used to. Setting his game stick down beside the main control ball, he watched as Max put a complex schematic onto the nearby viewer. The affected bearing flashed in red; tracing a curve on the control ball with his finger, Tomo had the view enlarge and rotate. He debated changing his mind and asking for a complete hologram, decided the bearing's orientation was clear enough from the flat. The data box beneath the schematic directed him to Level Four, access panel four-twenty-six. Stepping to the circular staircase, he picked up his tool belt from its holder and started down.

Level Four was an equipment deck, with the sort of floor plan that could only be approved by someone who'd never have to work there. It took Tomo three minutes to work his way back to panel twenty-six, two more to get the plate off, and two more after that to find a comfortable position to work in. "Has Maigre Port sent you our manifest and next destination yet?" he asked Max, prodding a bolt experimentally with his wrench.

"Yes," the computer answered. "The main items are bioelectronics and exotic foodstuffs; we'll be taking them to Canaan Under Vega."

"Tricky stuff, bioelectronics. Should be good for, what, a seven-day layover?"

"The port has scheduled us for eight point five. Is the number significant?"

"Well . . . " Tomo paused, wondering whether he ought to bring this

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up. It seemed like such a crazy idea, sometimes, even to him. Still, he was going to have to talk to *someone* about it, and Max at least wouldn't laugh at him. "Tell me about Maigre. What's it like?"

"The design is a common one: a rotating disk in equipoint orbit, with docking facilities—"

"No, not the space port," Tomo interrupted. "I mean Maigre the planet."

"I'm not sure I understand the question. Do you want physical or sociopolitical data or something else entirely?"

"Oh, never mind." Tomo picked up another tool and got back to work. "I just . . . Actually, I've been thinking about maybe—well, maybe going dirtside this layover. Just to see what life on a planet is really like."

There was a short pause. "I see," Max said in a surprisingly neutral tone. "Actually, I don't believe you'd like it. Conditions are vastly different than they are on the *Goldenrod*. There are large, open areas without walls or ceilings—"

"I know, I know—I've seen all the tapes. I just thought it might be . . . interesting . . . to see it for real."

"I see. How long have you been thinking about this?"

Tomo had the computer's tone pegged now. "Oh, no you don't," he shook his head, grinning. "That 'I see' opener is a dead giveaway you've tied in your psych program. You're not starting me on that silly motivation questionnaire just because I've been thinking about planets and people lately." With a gentle tug he removed the top half of the damaged bearing shell, the bottom half dropping neatly onto the grab-cloth he'd spread out beneath it.

"Lately?" Max persisted.

Tomo twisted his head to send a mock glare at the computer monitor. "Max—"

A beep from the pod-to-pod interrupted him. "Tomo?" a voice asked. "What's the word on that antenna?"

"No problem, Andra," Tomo assured him. "Just a fatigued bearing shell. Take me a couple of hours to replace it."

"Good. I don't like dockings even when Max has all six close-approach systems to work with. I'd hate to try it with one missing."

"Aw, come on—you'll have Max thinking you don't trust him."

"*Max* I trust. It's those rinks who're supposed to hold the port steady for us. They're all dirtsiders at heart, you know. Lunatics, every last one of them."

"Yeah." Tomo grinned, then sobered. "You've never actually been dirtside yourself, have you?"

Andra snorted. "What kind of crazy question is that? Of course not."

"Right. Stupid question," Tomo backtracked quickly, mentally eliminating Andra as a possible confidant on this. "Everything else checking out?"

"Far as I know. Max?"

"Everything is functioning properly except for the antenna Tomo is repairing," the computer replied.

"Good," Andra said. "I'll let you work in peace, Tomo. Signing off." A second beep signaled his departure from the voicelink.

"Doesn't sound like I should invite Andra to come down to Maigre with

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me, does it?" Tomo remarked, striving to keep his manner light.

"Tomo—" Max began, in neutral tone again.

"No, let's just drop it for now, okay?" Tomo interrupted. "It's just a random idea—it hasn't got any deep psychological significance or anything."

"As you wish."

"Good. Though I'd appreciate it if you'd keep all of this secret. Andra will be riding me all the way to Canaan Under Vega if he gets hold of it."

"I understand." There was just the barest of pauses. "I'll keep the conversation private."

"Thanks." Climbing to his feet, Tomo squinted at the inside of his bearing sphere half. "Now, how about looking up which locker we keep spare FST-938 bearings in?"

Dr. Alexei Ross was already in a foul mood when the station computer told him Director Halian wanted to see him in his office. "*In* his office?" Ross asked, not sure whether to be angry or astonished at the request. "Is something wrong with the intercom system?"

"The intercom is functioning normally," Iris replied. "Director Halian said to tell you that the sensitivity of the topic required a face-to-face meeting."

"Probably his exact words, too," Ross grunted. For a moment he considered refusing on the truthful grounds that he was too busy to go running all over Maigre Space Station just because Halian felt like being melodramatic. Parallax Industries might own most of the station, but as chief physician Ross was explicitly out of Halian's direct control. But even as he mentally considered sending back a borderline-nasty message, logic prevailed. If Halian wanted to discuss something without the risk of being overheard, he probably had a damn good reason for it. Possibly something new on the G- and H-deck thorascine leaks that had put forty-five people in Ross's ward in the past twenty hours. "All right," he sighed. "Inform the director I'll be down as soon as I can."

"Yes, Doctor. Also, the bioscan data is in on Marc DeSabia now; my analysis indicates thorascrine concentrations in liver, kidneys, and thyroid gland."

"Okay." Ross spent a few minutes logging orders that weren't part of Iris's standard medical procedure programming and leaving contingency instructions for his staff. Then, still fuming a bit, he stalked to the elevator and rode down to W-deck and Parallax Industries' executive offices.

Director Jer Halian was staring out the oval porthole when Ross stomped in. "This better be important, Jer," the doctor said, stepping over to Halian's desk and sitting down in the plush guest chair. "I've got a ward full of people upstairs who still need all my attention."

Halian turned to face him, and Ross saw for the first time the other's expression. It wasn't an encouraging one. "Anyone died yet?" the director asked, his mind clearly on something else entirely.

"No, and I'd like to keep it that

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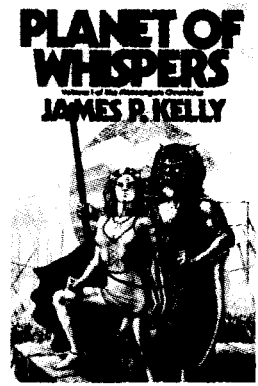

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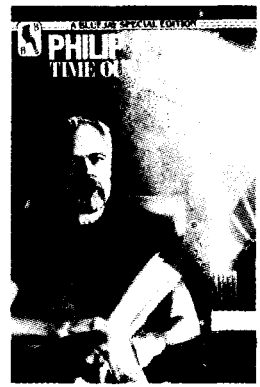

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way." Ross rubbed at his forehead, grimaced at the perspiration oils there. "Another ten hours and this last batch should be out of danger."

"Good." Halian took a deep breath. "Because in about ninety-*five* hours we're going to have an even worse mess on our hands. One of the *Goldenrod*'s mainters apparently wants to visit Maigre during his layover."

Ross felt something prickly dock between his shoulder blades. "Holy drine. You sure?"

Halian picked up a cassette and rolled the slender cylinder across the desk. "The *Goldenrod*'s MX computer sent me this private report a half-hour ago. The mainter refused to discuss it in depth, so all the MX could give us was his last general psych profile." He leaned forward a bit. "This *is* a problem, now, isn't it? I mean, this Tomo character *won't* be able to stand it for long down there, will he?"

Ross snorted. "It's even worse than that. He shouldn't even *want* to try mixing with other people, any more than you'd seriously consider spending your life in a starship pod. The very fact he's talking this way means he's already in serious trouble."

"Great," Halian said heavily. "Just what we needed."

A sudden, horrible thought occurred to Ross. "He's not *flying* the ship, is he?" Visions of the freighter ramming full-tilt into the station—

"Oh, no—no way he can take control away from the computer, either," Halian assured him. "*We're* not in any immediate danger."

"I'm sure that's a great comfort to the rest of the *Goldenrod*'s crew," Ross said dryly.

"They're not in danger, either, at least not at the moment. In fact, they don't even know anything's wrong."

"Handy. Sounds like one of your ideas."

Halian didn't seem to notice the barb. "It was the computer's, actually. But never mind that. I want you to start getting your people and programs ready right away."

Ross shook his head. "I'm afraid we're not equipped to handle anything like this. We're going to have to bring a psychoses expert up from Maigre. I'll go check the medical directory." He started to get up.

"Hold it—*hold* it," Halian snapped. "We can't let outsiders in on this—the company'll have our heads if bad publicity gets out. What about that therapy session you put Randoff through when he went all flutey last month?"

Ross sank wearily back into his chair. "Jer, we're talking about a *starship mainter* here—the most carefully circumscribed personality type that's ever existed. As far as I know, no mainter has *ever* gone out the sunward lock like this, and I'm not going to trust him to a computer that hasn't even got a decent database to draw on."

Halian turned back to his porthole, and Ross saw the lines around his mouth tightening. "And there's no one on your staff who can handle it?"

"No." Ross shook his head. "Anyone who developed a problem this se-

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vere would be immediately shipped to a dirtside facility."

Halian grunted, and for a long moment the room was silent. Ross found himself staring at the model of a star freighter sitting on the corner of Halian's desk. Six long cylindrical pods, arranged hexagonally about the central drive cylinder, the whole thing tied together by a network of bracing struts . . . and each of those cargo pods someone's home for years at a time. The very thought of it made Ross's skin crawl.

"All right," Halian said, breaking Ross out of his uncomfortable reverie. "But get someone who can keep his mouth shut. And don't give him any more information than absolutely necessary. That goes for your staff, too."

"I'll do my best," Ross said, annoyed at the other's peremptory tone. Standing up, he snared the cassette with Tomo's psych profile and slid it into his pocket. "And in the meantime, you get *your* people on top of those thorascrine leaks. I can only handle one crisis at a time, and I want my ward empty when Tomo gets here."

Halian looked up at him with tired eyes. "Believe me, Doctor, no one wants those leaks stopped more than I do."

Ross felt his irritation with the other melting away. Halian was a solid company executive, but in spite of that he really wasn't a bad sort. "I know," he told the director. "I'll talk to you later."

A starship's natural environment, Tomo had always felt, was out in interstellar space, hundreds or thousands of kilometers from anything larger than an ice cube. Docking—actually bringing the ship into physical contact with a giant spinning disc—was thoroughly *un*natural and therefore the most nerve-wracking part of every trip. But Max performed flawlessly as usual, matching motions and gliding smoothly into the docking berth like an off-center axle. The port's spin gave the *Goldenrod* an effective gravity similar in magnitude but different in direction to what Tomo was used to, and he grimaced slightly as his floating crash chair came to rest against what he usually considered a wall.

"The access tunnel is connected now, Tomo," Max informed him as he unstrapped and climbed a bit gingerly from the chair. "Whenever you're ready . . . "

The tunnel led from the pod to a short corridor in the port proper, and a door at the far end opened to a spacious five-room suite. Tomo gave himself a quick tour, and then returned to the living room area. "Not bad," he said aloud. "Better than that cubist's nightmare at Burnish, anyway—remember that horrible holosculp?"

There was no response, and Tomo snorted at his forgetfulness. Of course Max had no direct voicelink pickups *here*. Stepping to the desk, he located the "communications" section of the control ball there and traced the proper curve among the many alternatives. "Max? You there?"

"Of course," the computer's voice answered. "What is it?"

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"Oh, nothing—I just wanted you around." He paused, eyes still studying the unfamiliar control ball. "Wait a second—can you tell me how I call up the port's computer on this thing?"

"I believe you'll need to interface through me for all computer functions."

"Oh?" A corner of Tomo's mind noted that such an arrangement seemed unnecessarily awkward; but these *were* port people, after all. "All right. Uh . . . would you call up a sky-to-ground shuttle schedule for me?"

"Very well."

The screen beside the control ball lit up with lines of numbers and words. Sitting down, Tomo leaned forward to study them . . . but he'd barely begun to decipher their meaning when the screen abruptly blanked and the face of a middle-aged man appeared. Startled, Tomo leaned back again.

"Welcome to Maigre Space Station, Tomo," the man said, smiling. "I'm Director Jer Halian, in charge of Parallax Industries' operations here. I hope you had a good voyage?"

"Quite nice, sir," Tomo managed, still feeling a bit off-balance.

"And I trust your rooms are satisfactory?"

"Oh, certainly."

"Good. Well, we want you to be comfortable for the duration of your stay. Is there anything we can do for you? Something special, perhaps, that we haven't thought to provide?"

Tomo took a deep breath. *It's not an unreasonable request,* he told himself firmly. "As a matter of fact . . . would it be possible for me to visit Maigre while I'm here? I'd sort of like to see what dirtside life is like."

Halian's expression didn't change. "I'm sure something can be arranged. Uh—" His eyes flicked to the side. "Why don't you come down to my office and we can work out a schedule for you?"

"Come down . . . in person?" Tomo asked, faltering a bit. Somehow, his rather hazy plan hadn't included consequences quite this immediate. "Can't we do it from here?"

Halian shrugged fractionally. "Oh, we *could*. But I wouldn't think it'd be a problem for someone who wants to visit a planet full of people."

It was nothing Tomo could put his finger on, but suddenly he felt like he was at the far end of a microscope. Halian was watching him closely . . . too closely . . . as if this was some sort of test . . . "You're right, of course," he told the director firmly. "How do I get to where you are?"

If Halian was surprised, he hid it well. "There are guidelights along the hallway walls; I'll have them set to lead you to my office. I—guess I'll see you in a few minutes. Good-bye."

"Signing off," Tomo nodded as the screen went blank. For a moment he sat there, working up his courage. Then, standing, he strode resolutely to the emergency door with its bold EXIT TO STATION inscription. Almost unwillingly, his hand reached out to touch the red plate, and with a gentle *whoosh* the door slid open. Licking his lips quickly, Tomo stepped through—

And jumped back inside, using a hand

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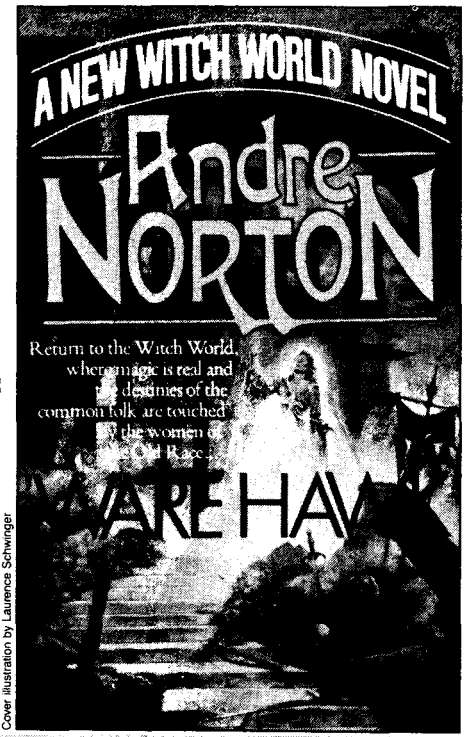

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on the door jamb to swing off to the side. Back flat against the wall, he mouthed a silent curse at the still-open door. Finally, it slid closed . . . but not before the two men he'd fled from had time to pass by.

He stood there for several seconds, slowly mastering the emotion of that near-contact. Unlocking his frozen joints, he peeled himself from the wall. He tried to step to the door again, but his feet seemed unable to take him that direction. The touch plate glared mockingly at him; turning away, he returned to the desk and gingerly sat down. "Max," he croaked.

"Yes, Tomo?"

He licked his lips, and this time they worked better. "Get me the director's office, will you?"

"Certainly. Are you all right? You sound agitated."

"Just make the call, huh?"

Max didn't answer, but a moment later Halian's face appeared on the screen. "Yes, Tomo, what is it?"

"Sir . . . would it possible for *you* to come *here* instead?" Tomo asked. "At your convenience, of course, and if it's not too much trouble."

"No trouble at all. I'll be up in a few minutes. Is it all right if I bring a couple of colleagues with me?"

Tomo wanted very much to say no, but Halian had that microscope look again. "Uh . . . yeah, sure."

"Good. We'll see you soon then. Good-bye."

The screen blanked and Tomo wilted a bit in his chair. *No trouble at all,* the director had said airily, as if taking a trip through a crowded port was the easiest thing in the universe.

Unbelievable!

Director Halian turned off the intercom, sent a glance at Dr. Ross, and then focused his attention on the newcomer. "Well, Dr. Scharn?" he invited.

Dreya Scharn shrugged, wondering what the flapdoodle secrecy was all about. To her, the whole thing seemed absurdly open-and-shut. "If it were anyone but a starship crewman I'd class him as a severe case of anthropophobia and start chemo-imbalance correction immediately. But surely you realize that after however-odd many years in space, any of us would be pretty weak in the social-contact areas. I'd suggest you give him a few days before you start getting worried."

She stopped, suddenly aware that their reactions didn't fit what she was saying. "Is something wrong?"

Halian cleared his throat, flashed an annoyed look at Ross. "I see Dr. Ross hasn't given you the whole story yet."

"Sorry, Jer," Ross said, with the brusque manner of someone on the defensive. "But I didn't want to say too much until Dr. Scharn arrived—and I was expecting Tomo to give us a little more time." He turned to Scharn. "You see, Doctor, it isn't exactly Tomo's fear of people that concerns us—as a matter of fact, that's a normal part of a starship mainter's personality. The problem—"

"Just a minute," Scharn interrupted. "Are you telling me Parallax Industries is using mentally disturbed people to fly its starships?"

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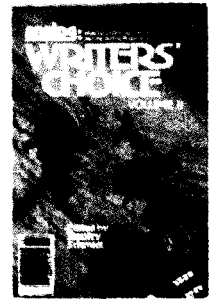

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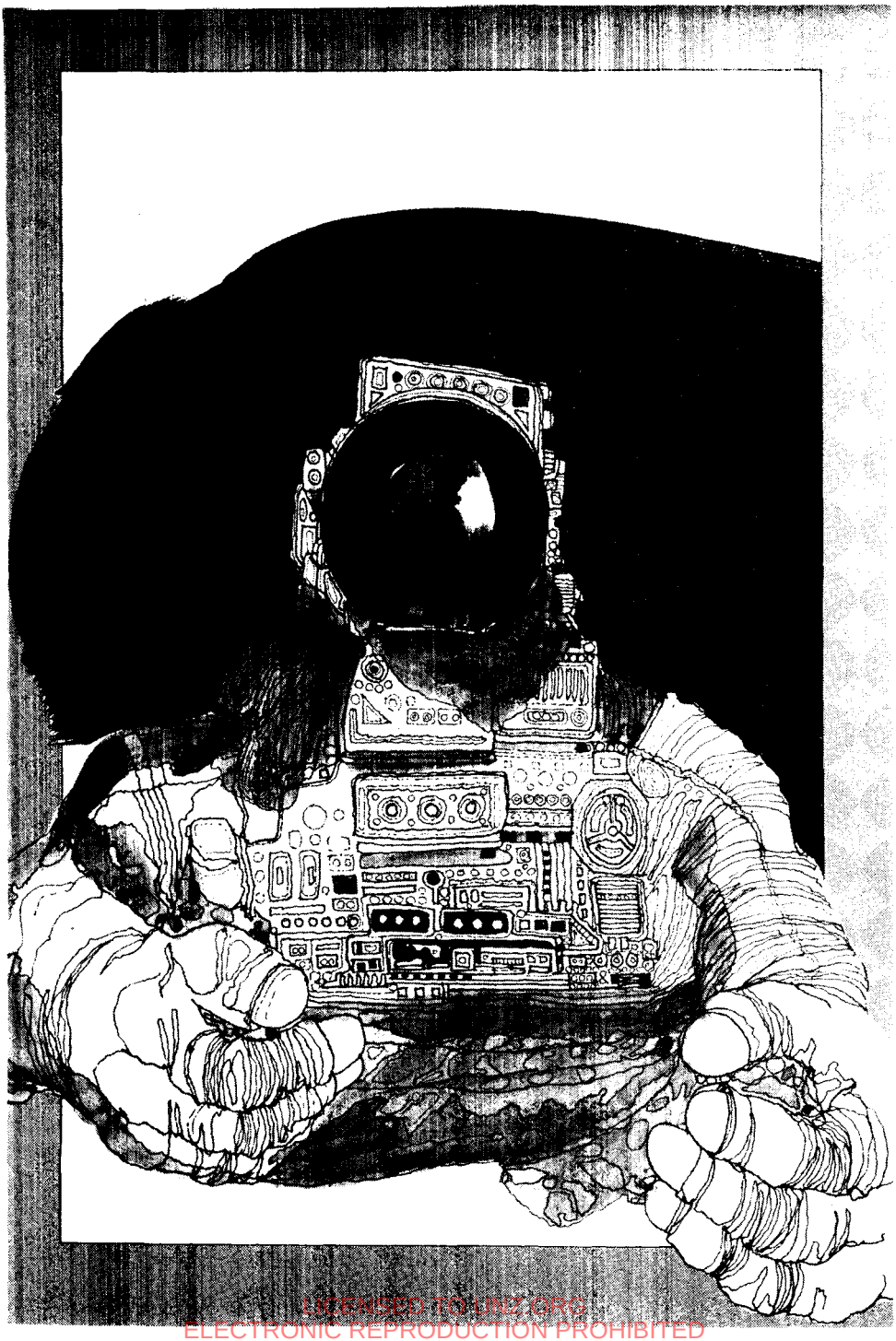

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"No, of course not," Halian said before Ross could answer. "The mainters are perfectly sane and well-adjusted . . . within their own parameters."

"Mr. Halian, there's no way you can consider extreme fear of people to be within the bounds of normal sanity."

"I said 'within their parameters,' " Halian reminded her. "Mainters are specially chosen for loner characteristics."

Scharn cocked an eyebrow. " 'Chosen'?"

Halian's eyes slipped just a bit from her gaze, but his nod was firm. "Yes."

Truth-bender, she labeled him silently. She considered pressing the point, decided to file it for later. "All right. Then if anthropophobia isn't Tomo's problem, what is?"

"The fact that he's talking about taking a trip dirtside," Ross said. "A mainter shouldn't even be *thinking* things like that, let alone seriously considering them."

"Why not?" Scharn frowned. "Maybe after—this is what, his third voyage? Maybe after twenty-odd years on a starship he wants to try something new."

"If one of your patients said he wanted to jump off a highrise without an air belt, would you say he just wanted to try something new?" Ross countered.

Scharn glared at him. "That's an absurd comparison and you know it. People can't fly, but even extreme loners can learn to deal with crowds."

Halian shook his head. "Mainters can't. That's the whole point."

For a moment Scharn stared at him, something cold starting to stir in her stomach. "Then we're not talking about people who've simply been *chosen* any more," she said coldly. "What you're saying implies a great deal of mental conditioning, very likely illegal as well as unethical."

"I assure you, Doctor," Halian said, "that Parallax Industries is not engaged in any illegal activities. As for ethics, I think you'll find things aren't as simple as you might imagine."

"Oh?" Scharn gave him a hard smile. "Then perhaps it's time I found out how 'things' really are. And it'd better be a *complete* explanation."

"Not to change the subject," Ross interjected, "but before we get into anything lengthy, shouldn't we go upstairs and see Tomo? He *is* expecting us, remember."

Scharn kept her eyes on Halian. "I can't begin any kind of diagnosis until I know exactly what I'm up against."

"You'll get the complete explanation—I promise," the director said. "But Ross is right. Perhaps you can treat this as an orientation session or something."

Scharn hesitated, but this time she sensed Halian was telling the truth. "All right. Let's go, then."

The elevator trip was the oddest Scharn had ever experienced. She knew enough to be ready for the change in weight as they moved toward the station's rotation axis, but she'd forgotten about the Coriolis effect that nudged her sideways into the wall and held her there for the embarrassing seconds it took to get her feet back into position and lean

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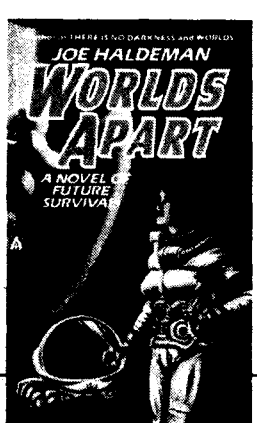

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into the pseudoforce. Halian and Ross ignored her clumsiness, but she knew they'd seen it. She was glad when the car finally slowed and came to a halt.

The corridors were another surprise, though a little reflection told her she should've expected this, too. Several decks above the station's living and business areas, there was no call for bright colors or cushiony carpeting here. Only cargo handlers and station mainters used this area, and they were more interested in utility than aesthetics.

The door Halian led them to was like all the others they'd passed, except that its ID label was lettered in bright red and cautioned the prospective entrant to check with the station computer to make sure no starship mainter was inside. The warning gave her momentary pause—was there something dangerous about starship mainters?—and she hastily searched her memory for anything she might have heard on the subject. But Halian showed no hesitation as he stepped to the door and pushed the hailer. Scharn heard a soft ping, and an even softer reply, and Halian fingered the touch plate. The door slid open and they walked in.

Tomo was standing behind a small desk across the room, his back solidly against the wall. His expression was one Scharn had seen before, on nervous lab animals.

"Hello, Tomo," Halian said. "I'm Jer Halian. Sorry we were delayed a bit."

Tomo nodded once, a quick up-down jerk of his head. "Hello," he said.

Scharn's peripheral vision picked up a couch to their left, a couple of meters farther from Tomo's position than they were now. "Couch," she murmured, nudging Halian.

For a wonder, he caught the hint and led them over there. They sank into it, and Halian gestured to the desk chair a meter in front of Tomo. "Won't you sit down, too?"

Tomo's eyes flicked to the chair, then back to his visitors. Gingerly, he pulled the seat back to rest against the wall beside him and sat down.

"Well," Ross said briskly. "Tomo, Director Halian tells us you'd like to take a trip down to the surface while you're here. We'd like to talk to you about that, if we may."

Some of the tension left Tomo's face, to be replaced by suspicion. "You sound like Max in his psychological mode. Are you a psychiatrist?"

"No, no—I'm Dr. Alexei Ross, chief physician of Maigre Space Station. You must understand that your safety —whether here or dirtside—is our responsibility, and we have to make sure you're properly fit before we can let you go. The gravity's twice what you're used to, for starters."

If Ross had hoped to distract Tomo from his original question, it didn't work. Shifting his gaze to Scharn, he asked, "How about you?"

"I'm Dr. Dreya Scharn," she began; but before she could go on, Halian jumped in.

"Dr. Scharn's from Maigre proper, Tomo," the director said. "We brought her here because she knows more about dirtside conditions than anyone aboard the station. She has some questions she

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needs to ask you before we can discuss your trip to the planet."

Scharn managed to keep her professional face in place, but it was a near thing. To half-lie about her profession and then drop the conversational burden directly into her lap was a double whammy she hadn't expected. But she was damned if she was going to let Halian's action throw her. Smiling at Tomo, she opened with the simplest time-buyer in her repertoire. "Why don't we start by getting to know you better, Tomo. What was your childhood like?"

"You mean my trainage?" Tomo asked, still looking wary. "Just like anyone else's. Lynn—that was the station's LNN Learning Computer—taught me how to inspect and repair all the machinery on board a starship. When I'd learned everything I was assigned to the *Goldenrod*."

"What were your parents like?" she asked.

A flicker of puzzlement crossed the mainter's face. "Parents?"

"He won't remember any human parents or nurses," Halian murmured in Scharn's ear. "He'd have been taken away from them when he was young."

"I see," she said, trying hard to keep her astonished horror from showing. Mental conditioning was a well defined, if seldom used, psychological tool, but never had she heard of it being started so early in a subject's life. The legality of this whole thing was getting shakier and shakier. "Were you lonely as a boy?" she asked Tomo. "You had playmates, didn't you?"

"Of course. I already told you about Lynn."

"No, I mean other children. Did you play with any of the others at your station?"

Tomo shrugged fractionally. "I sometimes played with Orbin on the viewer. I liked playing alone or with Lynn better, though. Look, what does all this have to do with my fitness to go dirtside?"

A damn good question, Scharn thought. "We wanted some idea how much experience you've had interacting with other people," she improvised, hoping it sounded reasonable. "So after your training you went aboard the *Goldenrod*. Do you get along with the other mainters?"

"Well enough. We don't talk to each other much."

Scharn frowned. "You mean you're all together in the same ship for years at a time and don't do things together?"

"We're not really *together;* we've each got our own pod, you know. And there usually isn't any maintenance that requires two of us working in sync. Max flies the ship and tells me when there's work to do; the rest of the time I read or play music or fiddle with my electronics kits."

The starship model Scharn had seen on Halian's desk suddenly made sense. Six mainters, six mutually isolated pods . . . "So you really *are* all alone out there."

"Pretty much, except for Max."

"I see. How do you feel about being alone? Does it ever bother you?"

Tomo snorted. "Of course not. What

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kind of stupid question is that?'' His eyes flicked between Scharn and the others. ''What's going on here, anyway?''

Scharn raised her hands chest high, palms outward, in a soothing gesture she hoped Tomo would understand. ''All right; let's get back to Maigre, then. Can you tell me exactly why you want to visit the planet?''

Irritation was beginning to replace the tension in Tomo's face. ''Why is everyone making such a big deal about this?'' he snapped. ''I've never been dirtside before and I got curious about it. Haven't any of *you* ever wanted to try something new?''

''Of course we have,'' Ross put in. ''It's just that dirtside conditions are *so* different from starship life that we wanted you to understand exactly what it would be like. On a planet, you see, you have wide, open-roofed spaces—''

''I know—Max already gave me the full list. I can get used to it.''

''There are also people down there,'' Scharn reminded him. ''*Lots* of people. It seems to me you're having trouble right now, with just three of us in the same room with you.''

The tension flooded full force back into Tomo's expression, and Scharn had the sudden impression that he'd halfway convinced himself that his visitors were actually just images on a viewer screen. ''I can manage,'' he ground out. ''If you can get used to a port, I can get used to a planet.''

''You're talking nonsense, Tomo,'' Halian said, his frustration evident in his tone. ''You're a starship mainter—you don't belong on a planet.''

''Do people belong on Charon's World?'' Tomo retorted. ''Or Tau Ceti? Human beings can adapt to practically *anything*.''

''Sure they can. Except that—''

Halian broke off abruptly; at the same time, Scharn sensed Ross jerk in reaction. She turned back and forth quickly, trying to catch the men's expressions before they could be covered up. She saw enough to decide it was time for a showdown. Turning back to Tomo, she said, ''I think we'd better leave you for a while, Tomo. I need to discuss a few things with Director Halian before we talk any more about your trip to Maigre. In the meantime, though, I'm sure you could walk around the station if you'd like. It's not a planet, but it would give you some practice in getting used to other people.''

She stood up, Ross and Halian following suit. The latter gripped Scharn's upper arm in a reaction that added fuel to her suspicions. ''I'm not sure letting him run loose is a good idea,'' the director whispered.

''Good-bye,'' Scharn smiled at Tomo. She stepped past Ross, the movement forcing Halian to release his hold on her arm, and led the way out of the room. As the door closed she got a glimpse of Tomo sagging in obvious relief.

''Dr. Scharn,'' Halian said, again taking her arm, ''he should *not* be allowed free access to the station—''

She shook off the hold and started down the corridor. ''Let's go to your office, Mr. Halian,'' she called back

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over her shoulder. "We've got a lot of talking to do."

The return trip was made in chilly silence. Scharn held her fire until Halian was seated behind his desk again, and then let him have it.

"I don't know what you think about miracle cures and psychiatry," she bit out, "but I can assure you that I won't be able to do the job *you hired me for* unless I start getting some straight answers."

"I know," Halian said, waving her toward the seat she'd occupied earlier. "Sit down, Doctor."

She remained standing. "I mean *genuinely* straight answers. First Tomo was *chosen*, then he was *conditioned*, and now you've practically bitten your tongue off because he started talking about what humans can do. Now, either you give me the whole story or you schedule me a seat on the next shuttle back to Maigre."

Halian stared up at her in stony patience for a couple of heartbeats after she finished her speech, then once more indicated her chair. "Sit *down*, Doctor."

She hesitated, then obeyed, realizing with some chagrin that Halian was still in control of the situation. Psychological training, apparently, was no match for the experience gained in boardroom battles.

"You're right, of course," Halian said. "We should have told you everything right away. I suppose my only excuse is that you're an outsider, and that after a certain number of years keeping secrets away from outsiders becomes a very strong habit." He shifted his gaze to Ross. "Doctor? You know the details better than I do."

Ross pursed his lips briefly. "As I'm sure you know, Dr. Scharn, every human personality trait is a product of both heredity and environment, the genetic arrangement forming a sort of bedrock infrastructure of tendencies and aptitudes on which the individual personality is expressed." He paused. "What you may *not* know is that any of these genetic tendencies can be . . . *enhanced*, as it were, to a point where none of the subsequent environmental factors can really affect it. That's basically what's been done to Tomo."

She'd halfway been expecting this, but hadn't really wanted to believe it. "Are you saying," she said carefully, "that you've genetically engineered that entire corps of starship mainters to be *afraid* of people?"

"Not on purpose," Ross said. "The procedure was designed to make them able to tolerate—even enjoy—years of solitude at a time. Apparently the anthropophobia comes as an unavoidable part of the package."

"The *package?*" Scharn exploded. "My *God*—these are *human beings* you're talking about. *People* you've deliberately warped." She glared at Halian. "And it is most *cer*tainly illegal."

The director didn't flinch. "As a matter of fact, Parallax Industries has a special exemption from the general laws on genetic engineering. And if it helps any, I was just as outraged as you are when I first found out about this."

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"You've done a good job of silencing your conscience, then," Scharn said coldly. "Does Parallax pay *that* much?"

"It's not a matter of personal bribery. It's the simple fact that the benefits of interstellar trade vastly outweigh the costs."

"Oh, of course," she retorted. "The costs are negligible—unless you happen to be one of those people out there."

"I'd advise against hypocrisy, Doctor," Halian said, a touch of irritation showing through his executive mask. "You benefit as much from the trade as anyone else, and I doubt you've ever given two seconds' thought to the people who provide you the goods."

"Don't shift the burden to *us*," Scharn bit out. "If people knew you were using genetic slavery they'd give up their precious furs and exotic foods like a shot."

"And their last fifteen years of life, too?" Ross asked quietly.

Scharn turned to him. "What?"

"Fifteen years is the extra life expectancy that out-system medicines have provided us," he amplified.

The first hint of uncertainty began to play around the edges of her anger. "Medicines can be synthesized, though, once the molecular structure's known," she pointed out. "Intersystem lasers can transfer the knowledge at that point."

"Usually," Ross nodded, "but not always. Have you ever heard of Willut's Chaser?"

Scharn frowned. "I think so. Isn't that that weird semi-living chemical that seeks out cancerous cells?"

"That's the one. Revolutionized the whole treatment procedure, made it possible for the first time to really root out an entire tumor without doing even a scrap of damage to the surrounding healthy tissue. And after sixty years we still can neither synthesize it nor successfully cultivate the Altairan nematoid strain that produces it."

There was a moment of silence. Scharn tried to whip up her righteous anger again, but her sister's face kept getting in the way. Maia, who had spent a couple of days in a hospital ten years ago for the routine treatment of brain cancer . . . "Why don't you build larger ships, then, so that you could use normal people running the ship as a group?" she asked. "Better yet, how about complete automation?"

"Because we'd need freighters the size of the original colony sleeper ships to give a normal crew the kind of room they'd need," Ross told her. "Anything smaller and you'd have violence and psychoses within the first five years, no matter how carefully you screened the crews." He hesitated. "Parallax tried that once; the records of those voyages aren't pretty."

"Then why not automate?" Scharn persisted. "Surely a powersat TPL computer and its mobile units would be able ex12to handle whatever maintenance a starship needs."

"The problem," Halian said, "is that a TPL, or any computer that powerful, requires an extremely high-density memory system, and high-density systems are notoriously vulnerable to radiation damage. On a powersat that's not a problem because you can afford

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the weight of extra shielding and you have continuous error-weeding by ground-based systems. On a starship —well, the drive radiations aren't really dangerous to biological tissues, but your TPL would be out of commission in two years at the outside. Putting multiple units aboard would slow the process, but not enough."

"But . . . " Scharn raised a hand in a frustrated gesture, let it drop impotently to her chair arm. "It's still immoral to do that sort of thing to human beings."

Ross shrugged uncomfortably. "Would you rather we try putting normal people in what amounts to solitary confinement for ten years? Risk their going permanently insane or else drug them to their eyelids and never mind the physiological consequences? Don't forget, the mainters truly *like* what they're doing. They really *are* happy out there."

"All except Tomo," Scharn said.

Halian nodded grimly. "All except Tomo. He's an unknown, Dr. Scharn; and along with being worried I don't mind admitting I'm scared. What other supposedly impossible thoughts might he be having? Could he be going paranoid, too, or even homicidal?"

Scharn pursed her lips tightly. She still didn't like what had been done to Tomo . . . but her immediate responsibility was not for his past but for his present. And if he posed any danger to either himself or the station. . . . "Do you have anything like a standard psych profile for the mainters as a group?" she asked.

Halian's response was to reach for his desk's control ball, fingering the classified-access section. "We've got both that and Tomo's own last profile."

"Good," Scharn said. "I'd also like any previous readings on Tomo that you might have."

Halian's screen lit up with lines of print, and he swiveled it to face her. "I'll have the *Goldenrod*'s computer send us a complete dump. In the meantime, here's the general mainter profile."

Putting her feelings on standby, Scharn began to read.

It had been nearly an hour since the others had left him; long enough for Tomo's panic to have subsided into emotional fatigue and then resurface as restlessness. Scharn had said they would talk again later, a statement that could qualify as either a promise or a threat. Whichever, he wished they would hurry up and get on with it. Waiting like this was worse than docking—then, at least, Max could keep him informed as to what was happening. Here at the port, they were both in the dark.

Or were they? "Max?" he called impulsively, sliding into the desk chair.

"Yes, Tomo?"

Just as quickly, he recognized the absurdity of what he'd been about to ask. "Oh, never mind. Um . . . how's the unloading going?"

"Unloading and refurbishing operations are proceeding smoothly. Is there anything I can get for you?"

"No, no. I'm just—I'm fine."

"I see." Max paused. "Tomo, would you mind coming back aboard ship for

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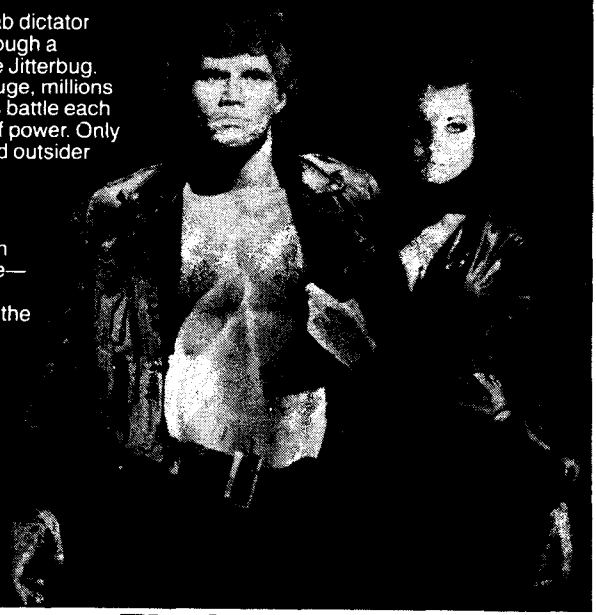

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a few minutes? There's no one in your pod at the moment."

Tomo frowned. "Why?"

"Your tone of voice indicates stress. My biosensors can't take readings outside the ship."

"I'm all *right*, Max," Tomo snapped. "Why is everybody so interested in me all of a sudden? The second I get here Halian calls me up, then he smothers me in doctors, and now *you*—"

He broke off abruptly, seeing for the first time the pattern there. But how . . . ? "Did you tell them that I was talking about going dirtside?" he asked suspiciously. The computer remained silent. "Max! Answer me!"

"Tomo, I had no choice. I cannot keep secret information that indicates you may be suffering physical or emotional dysfunction. Under such conditions I must report my findings in coded form to a company grade-one executive as soon as possible—"

"Wait a second. *What* physical or emotional dysfunction?"

There was a short pause. "Your thoughts about a planetward trip were judged to be four sigma outside normal range. A two-sigma deviation is considered—"

"Max, how many times do I have to tell you that there's *nothing significant about that?*" Tomo snarled, barely controlling his anger. This whole thing was becoming ridiculous. "Why are you making such a major operation out of it?"

Max's answer, when it finally came, was a complete surprise. "I'm sorry; I cannot continue this discussion."

Tomo's anger vanished into puzzlement and a slowly growing uneasiness. "What is it, something I'm not supposed to know?"

"My programming requires me to protect your emotional well-being. There are certain topics of discussion which would unduly distress you, such as descriptions of warfare or—"

"But this is something a lot more personal than warfare, isn't it?" Tomo interrupted, blocking Max's attempt to sidetrack the conversation. "Something having to do with my physical or psychological makeup, right?"

"I'm sorry; I cannot continue this discussion."

Aha, Tomo thought. For a moment he gazed into space, searching for a usable loophole. "All right. The information might—*might*—bother me. Correct?"

"I'm sorry; I cannot—"

"Shut up! It *might* bother me—but now that I know something's wrong with me, the uncertainty is *definitely* bothering me." He paused, but Max remained silent. "The tension alone—you know better than I do what prolonged tension does to blood sugar and adrenaline levels. Did your programmers anticipate this kind of situation?"

"They did," Max said in resignation. "Very well, then, but the information must be kept secret from the *Goldenrod*'s other mainters."

"Agreed. So?"

"In order to endure the solitude of starship service, you have undergone a kind of mental conditioning which has

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made you less dependent than the average person on social interaction."

For several heartbeats Tomo just sat there, attempting to assimilate the right-angle turn his private universe had just taken. *Egocentrism*, he thought through the numbness. *The assumption that you are basically the norm.* He'd known the people on planets and ports were different; but somehow he'd never considered the possibility that *he* was the odd one. And to have been deliberately *made* this way . . . "How much less dependent?" he asked.

"It allows you to spend long periods of time alone, which is necessary for your job." Max's voice was soothing, as if he were doing his best to soften the shock. But his best wasn't very good. "But it also makes it extremely difficult for you to interact with others at close range."

"So because I wanted to do something you didn't think I *could* do, you slapped a 'dysfunction' marker on me and yelled to the authorities." The mental numbness was fading now, anger once more rising to take its place. "Is that it?"

"It has nothing to do with what I personally think," Max protested. "Your conditioning places specific limitations on your actions, limitations as laser-cut and well-defined as—"

"As your own programming?"

"I wouldn't have put it quite that way—"

"But that's what you were thinking, wasn't it? Well, I've got fresh input for you. *You* may be defined down to twelve decimals, but *I* am *not*. I'm a human being, and I can do anything any other human being can do."

"Tomo, your vocal stress levels are becoming—"

Tomo cut him off with a well-aimed slash at the control ball. Getting to his feet, he stomped over to the exit door. For a moment he stood there, anger battling common sense for supremacy. But the anger was far stronger. Slapping the touch plate, he stepped out into the port corridor. This time, no one was in sight. Picking a direction, he started off, determined to find his way to Halian's office. Halian, Scharn, Ross, even Max; he'd show *all* of them.

The deviation between the two curves was small—well within the one-sigma accepted tolerance—but with the advantages of hindsight it was obvious to Scharn that that was where it had begun. "Right there," she told Halian and Ross, tapping the spot on the screen. "You can see the slip starting to form as early as a year ago."

"Too small a change for the MX to key on," Ross muttered.

"I wasn't blaming the MX," Scharn said, leaning back in her chair. "And it brings up an interesting question. Is Tomo becoming mentally unbalanced, or is his genetic programming somehow unraveling and allowing his personality to drift more toward human norms?"

"How could it do *that*?" Halian asked. "A genetic effect like that should be permanent."

Scharn shrugged. "In theory, so should damage to a section of mature brain. But stroke and accident victims

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routinely regain lost functions as the neural pathways restructure themselves. Perhaps some combination of hormones and neurotransmitters is acting to counteract the genetic bias here."

Halian harumphed. "I don't buy that. Anyway, I can't see that it makes any practical difference—"

"Of course it makes a difference," Scharn shot back. "In the first case he's ill and can probably be treated with some form of chemo-imbalance correction. In the second, though, what we actually have is a rapid version of personality evolution, which is not only normal but could be dangerous to suppress artificially."

"I believe," Ross interjected quietly, "that Mr. Halian was referring to Tomo's continuing presence aboard the *Goldenrod*."

It took a moment for Scharn to pick up exactly what he meant. "You mean leaning toward sociability will make him less able to stand solitude? Um . . . Maybe, maybe not. It depends partly on whether—"

She stopped as a double ping sounded from Halian's desk, followed by Iris's cool voice. "Mr. Halian, *Goldenrod* Mainter Tomo has left his quarters and entered the station: moving spinward on corridor D-9. Do you have instructions?"

Scharn felt her stomach tighten. It had been her suggestion, but she hadn't really expected Tomo to act on it. Halian and Ross looked even more stunned.

"Full sector/level monitor until further notice," Halian instructed the computer. "Is anyone else in that immediate area?"

"Negative," Iris reported. "D-8, D-9, and D-1 are clear."

"All right." Halian looked at Ross as if for advice, but didn't seem to get any. "All right, just monitor Tomo's movements and keep me informed. I'll be on mobile. Oh, and better lock down all computer outlets and elevators in his vicinity, just in case."

He picked up a small rectangular clip-on from the side of the viewer screen and stood up, the others following suit. "Let's get after him."

"Can't you seal him into that corridor?" Scharn asked.

"I could," Halian told her. "But it occurs to me that letting him run into a few people might be the best way to convince him that he can't handle that kind of social interaction."

Scharn's first reaction was that he was making an exceptionally poor joke. A half second later she realized he was serious. "And what if it merely drives him over the edge permanently?" she asked coldly. "Or don't you care about that?"

"He won't hit any heavily populated areas for quite some time without the elevators," Halian assured her. "If meeting with us didn't do anything permanent to him, neither will any situation he's likely to run into up there. Besides—" He hesitated. "The fewer people who know about this, the better. For *all* concerned."

Especially for you, Scharn thought bitterly. "I'm going for the sedation kit

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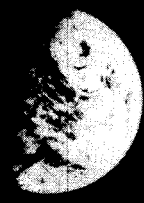

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I left in my quarters," she said. "Will one of you wait here for me?"

"We both will," Ross said before Halian could respond.

There was something in his voice that made Scharn look hard at his face. But whatever was wrong was too well hidden for a quick interpretation, and she didn't have time for anything else. "All right," she said. "I'll be right back."

Ross waited until the door had closed solidly behind the psychiatrist before turning to Halian. The director returned his gaze steadily; and after a moment Ross realized the other was going to make him raise the subject. He cleared his throat, glancing at the desk to make sure Iris's monitor was off. "You realize, of course," he told Halian, "that Tomo will pass through the thorascrine leak area on G-deck if he stays in 9-sector on his way down."

"That area's been adequately cleaned up," Halian returned evenly. "You certified that yourself."

"For us, yes. But Tomo's been in a medium-radiation environment most of his life. There've been reports that that can sensitize a man, make him much more susceptible to thorascrine poisoning." He paused, waiting for a reaction that didn't come. "But I see you already knew that, didn't you?"

"I may have heard of it somewhere. I don't remember."

"Sure." The sheer callousness of Halian's attitude was infuriating . . . and yet, even Ross could see the logic behind it. Legally, Tomo was less human than he was property, and Halian had both the right and responsibility of treating him as any other malfunctioning component. "Well," he said slowly, "I suppose it actually would make things a lot easier if Tomo got incapacitated somehow. The *Goldenrod* would leave on schedule without him and you wouldn't have to make a snap decision on his fitness for deep space. Scharn could take him dirtside and study him to her heart's content. The *Goldenrod* can manage with a missing mainter, can't it?"

"It can theoretically fly with even three of the six missing." Halian seemed to be having trouble meeting Ross's eyes. "The question then is what would happen to Tomo. If we take him off the *Goldenrod* he'll probably never be placed on another ship, even if he can be cured or whatever. So Scharn studies him for maybe a year or two . . . and then what? Starship mainting is all he knows how to do, and given his personality there's really nothing else he can be retrained for."

Ross felt his mouth go dry. To remove Tomo from his ship—by whatever means—was one thing. But *this*—"What you're talking now is way beyond an incapacitating injury," he said softly. "You're talking deliberate murder."

"I'm not talking *anything*," Halian said, his face unreadable. "I'm simply . . . thinking how an accident at this point would . . . simplify things."

This isn't happening, Ross thought as a sense of unreality seemed to darken the air between him and Halian. Premeditated murder . . . or was it? How

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human *was* Tomo, anyway? Form, intelligence—neither one was exclusive human property anymore. Genetic structure? Tomo's was no more human than that of any other biological construct. Surely there were legal guidelines, but Ross had no idea what they were. He could still raise a fuss, of course, and he could sense that Halian would back down at sun-grazer speeds if he did so, whether the director was in the legal right or not. But would that really do Tomo any favors? Because Halian was right—Tomo really *couldn't* do anything else. Unless Scharn's baffegab about some so-called personality evolution came true with a vengeance . . . but no, that theory was equal parts absurdity and wishful thinking. Which left Ross exactly where he'd started, at dead center.

In front of him, the statue that was Halian came to life, raising the clip-on he still held and flipping it on. "Iris? Status report on Tomo."

"He's outside the D-13 stairway . . . He has now entered . . . moving downward."

"Damn," Halian muttered. "Well, at least that tells us something. If he can still charge on into the station after suffering through that interview with us, it means he's past simple curiosity. He's up to full-fledged obsession." He fastened the clip-on to his tunic collar, leaving it active. "Come on. We'll pick up Scharn on the way."

Ross followed him to the office door, still wondering what he was going to do. It wasn't until they were outside in the wide corridor that he realized the

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decision had already been made. Halian had given him the chance to object; his silence had been interpreted as tacit agreement. *But that can be changed,* he told himself. *I can still stop this.*

But before he could do that, he needed to decide whether he truly wanted to . . . and the time for that choice was running out fast.

A starship pod consisted of eighteen one-room levels connected together by spiral staircases in flight and by simple hatchways when port docking changed the normal directions of up and down. The passageways linking the pods to the central drive cylinder were seldom used, but even they were simple tubes: straight, short, and without stairways or cross corridors. Never in his life had Tomo been anywhere nearly so confusing as Maigre Port.

He was almost afraid to admit it, but he was pretty sure he was lost.

The obvious solution, of course, was to ask for help; but so far he'd been unable to get any of the hall computer outlets to work. Until he found one that was live there was nothing to do but keep moving.

Ahead, still out of sight around the slight curve, he heard the sound of an opening door; and suddenly there were voices in the corridor.

Tomo's instinct was to freeze, but momentum and a sudden idea kept him moving. The voices were ahead and coming closer, but only a few meters in front of him was a cross corridor he could duck into. If he hurried . . . Putting on a last-minute burst of speed, he rounded the corner—

And practically ran down the two men crouched there.

With a strangled gasp, Tomo hurled himself toward the cross corridor's far wall, slamming back-first against it. He had just enough time to notice the open access panel and the scattered tools when the men charged him.

There was no chance for thought, no opportunity for anything but the most basic reflexive action. One of the attackers stepped in to block his continued passage down the corridor; slapping the outstretched arm aside with all his strength, Tomo ducked past and ran for it. Their shouts echoed weirdly behind him, partially drowned out by the thudding of his feet on the thin carpeting. He turned at the first opportunity and kept going. Three corridors and a stairway later he finally decided he'd lost his pursuers and slowed to catch his breath. Looking around, though, he could tell there was no use trying to fool himself any further.

He *was* lost now. Thoroughly.

"—and just crouched there looking scared. I went over to see if he was okay, and for no reason at all he hit my arm and took off like a meteor with fluorine afterburners. Till and I called for him to come back, but he just kept going."

Halian pursed his lips, glancing sideways to try and catch Scharn's reaction as they hurried down the corridor. Ross's reaction he could guess. "Either of you hurt?" he asked into his clip-on.

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"No, sir," the answer came. "Maybe bruised a little."

"All right. Just get back to work; I'll handle this. Good-bye." He waited for the termination click, then said, "Iris? Where's Tomo now?"

"Corridor F-39," the computer replied.

"Those workers probably just got in his way and he panicked," Scharn spoke up. "Mr. Halian, we've *got* to close him off from the rest of the station."

Halian could feel Ross's eyes on him. "I suppose you're right. Iris, seal all routes between decks G and H. Are there any security personnel above H-deck?"

"There are four, all currently on E-deck."

"Alert them, and have them start moving toward F-9. They're to try and box him in there—" he hesitated a fraction of a second—"or on G-deck if he gets that far. They're to use minimal force."

Scharn leaned toward the clip-on. "And warn them he's not dangerous so much as he is terrified," she added.

"Right," Halian agreed. "If they can avoid contact until we get there, so much the better."

"Acknowledged. Security forces are on their way."

Halian took a deep breath, let it out as inconspicuously as possible. *Stay calm,* he told himself. *Just stay calm.* "The direct-access elevator's right up here," he said, pointing.

They were passing K-deck when the first security report came in: one of the

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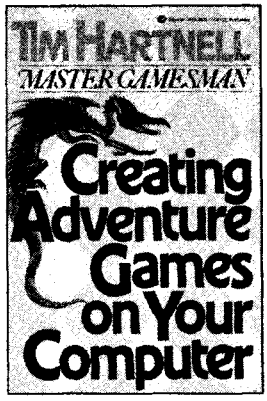

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guards had spotted Tomo in corridor G-9, forcing him to move into cross-corridor G-19B.

"Have the guard move just inside G-19B and wait there," Halian instructed Iris carefully. "Order the other three to approach from opposite directions along G-19, see if they can keep him from coming out there." He looked at Ross. "Ross . . . when we hit G-deck, I want you and Dr. Scharn to go down G-29, try to intercept him if he gets to one of the other cross corridors. I'll go up G-19B and try to cut him off there."

Ross's face was a sweat-plated mask as he gave a silent nod; but fortunately, Scharn didn't seem to notice as she dug a hypo tube from her belt pouch. "In case you do," she said, handing the tube to Halian, "here's a sedative—you can inject it anywhere. It's already set for Tomo's weight."

A moment later, they arrived at G-deck.

The corridor they stepped out into was deserted and, aside from normal mechanical noises, silent. Ross passed up the final accusing gaze Halian had half expected from him, taking Scharn's arm instead and heading away without a backward glance. Halian watched until they turned a corner, then permitted himself the luxury of a sigh. The die was now cast; Tomo's fate was in the hands of the universe. The thorascrine leak area was just one turn from the cross corridor Tomo had entered. If Halian had guessed the mainter's probable movements correctly he would soon be in the proper position to send the other "accidentally" through the center of the contaminated region. If the universe had other plans for Tomo, it would have to guide the mainter elsewhere, and under such circumstances Halian would have no choice but to accept its ruling. The director was several generations beyond the spacers who had built Maigre Station, but he still possessed a little of their traditional belief in fate . . . except that he knew the strong and the clever could build their fate as they chose.

Halian believed in fate. He did not necessarily believe in justice.

Turning, he hurried down the corridor. Tomo would be coming by very soon.

Leaning against the wall, Tomo wiped the sweat off his forehead and tried to catch his breath. Safe again . . . but only for the moment. They were closing in on him now; drawing the walls of their box closer and closer— "They won't hurt me," he whispered aloud. "I don't need to be afraid of them. I *don't*."

It was so much wasted breath. He *was* afraid of them, and there was no way he could pretend otherwise. The thought of their approaching him, maybe even *touching* him . . . he shifted his shoulders uncomfortably beneath the sweat-soaked coverall. If he could only get back to his quarters before anyone reached him . . . but he might as well wish himself a child again.

From the corridor ahead and to his left came the sound of footsteps. Tomo tensed; but even as he pushed away from the wall something within him accepted

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the inevitable. Standing rigidly, legs trembling with their mindless urge to run, he waited as the other came into sight and stopped.

"Tomo?" Director Halian called gently. "I've come to take you back."

Tomo remained where he was, not acknowledging Halian's words but not running off, either. Licking his lips, the director lowered his voice. "Iris? Secure from surveillance mode. I have Tomo in sight."

"Acknowledged. Sector/level monitor disengaged."

Halian flicked the device off . . . and he and Tomo were alone. "Don't be afraid," the director told the mainter, aware of the irony of his words. "I'm Director Halian—remember? Let me show you the way back to your quarters. You don't have to come close, just follow me at a distance. You can do that, can't you?"

Tomo's mouth worked once, but no words came out. Eyes unblinkingly on Halian, he nodded.

"Good. Come on, then." Walking carefully, Halian backed into the corridor he'd emerged from. A moment later, Tomo followed. Step by step they went, separated by the ten meters or so Tomo seemed to find comfortable.

Halfway down the corridor, still walking backwards, Halian stepped over the fuzzy line onto the thorascrine-stained part of the carpet.

A few more steps, Halian told himself, his eyes on Tomo. Once on the stain, his feet kicking up minute bits of the heavy dust, there would be no turning back. Whether enough remained to kill him or merely to make him sick, the important result would be the same: the *Goldenrod* would leave for Canaan Under Vega without the risk of an insane man aboard. After that . . . Tomo's fate would be in the universe's hands.

And midway through a step, Halian abruptly stopped.

Tomo stopped, too, five meters from the edge of the thorascrine stain, his face rigid with wary tension at the director's unexpected move. Halian stared at him for a long, painful second . . . and slowly a new truth dawned on him.

It was one thing to discuss death as a necessary and even humane action. It was another thing entirely to face the person involved and personally carry out the proposal.

He couldn't do it. And he hated himself for his weakness.

He took a step toward Tomo . . . and another . . . and with the third, Tomo's look of stunned disbelief changed to terror. *"No!"* he yelled as he spun and disappeared back into the other corridor.

Halian made no effort to chase him. His knees were weak with reaction, frustration and anger a bitter and debilitating taste in his mouth. He started to turn back, to recross the thorascrine and lose himself in the maze of corridors until the others could make the capture . . . but he'd taken only a couple of steps in that direction when the most chilling scream he'd ever heard jerked him around again. A dozen quick strides took him around the corner—

A hundred meters away Tomo was

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thrashing like a fish in the grip of two security guards.

Halian got to the scene in record time; but even so, Scharn and Ross managed to beat him. Tomo's whimpering rose to a final scream as Scharn reached between the guards with her hypo, a terrified shriek that left a ringing in Halian's ears even after it faded into silence. A moment later the mainter's last twitchings ceased. Scharn said something Halian didn't catch, and the guards lifted the limp form and carried him toward the elevators.

"Well?" a soft voice asked at Halian's side.

The director jumped; he hadn't really noticed Ross come over. "No," he murmured bitterly. "I lost my nerve."

Ross said nothing, but gripped Halian's arm briefly before hurrying to catch up with the others. Halian followed more slowly. *All right, Doctor,* he thought at Scharn's receding back. *You've got your chance now. And you'd damn well better not mess it up like I did.*

It was a long way up from the starless pit of unconsciousness, but there was something soothing in the darkness that removed any possible terror from the disorientation. Tomo had plenty of time to think and remember; and when he finally opened his eyes it was with total lack of surprise that he found himself lying in the lounge chair in his portside quarters. Attached to his right upper arm was a wide band, and he puzzled over it a moment before deciding it must be some sort of biosensory telemeter.

"Hello, Tomo."

He jerked at the quiet voice . . . but Scharn was only present via the viewer on his desk. "Hello, Doctor," he said, relaxing again.

"Sorry if I startled you," she apologized. "I wanted to talk to you and thought this would be the best way. How are you feeling?"

Tomo sighed. "Tired, mostly." He locked eyes with her image, "It's true, isn't it, what Max said. I've been conditioned to be afraid of people."

Scharn's lip twitched minutely. "More or less. That part wasn't done on purpose, but I don't suppose that's any comfort."

"Not really." Tomo closed his eyes, feeling almost relieved that it was over. No uncertainties remained; only cold, hard truth. "So that's it, then. I'll never be able to be with other people."

"Does that bother you?"

He shrugged. "I don't know. How can I miss something I've never experienced? It's just—" Something seemed to catch in his throat. "It's just that I know now that there's something normal people can do that I can't. It makes me . . . something less than human."

He opened his eyes in time to see Scharn catch her lower lip between her teeth. "There are a lot of things in this universe that some people can do that others can't," she said gently. "I could never spend years at a time alone on a starship—and even if I could, I wouldn't know the first thing about maintaining it. You can do both of those. It doesn't mean either of us is better or worse than the other; it just means we're different."

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"Maybe." Tomo paused, steeling himself for the crucial question. "Are you going to let me go back to the *Goldenrod?*"

He saw her eyes shift left, and knew she was checking some of his physiological readouts: reading from his body's reactions the state of his mind. The thought of being laid open like that before her didn't bother him; briefly, he wondered if it should. "I don't think that'll be a problem," she said after a moment. "If it's what you want, of course."

"It is," he said. "It's where I belong. The only place I ever will belong."

"Some people spend all their lives trying to figure out where they belong," she pointed out softly. "At least you've got that much."

Tomo looked at her . . . and slowly it dawned on him that the gentleness in her voice was perhaps less professional technique than it was simple pity. "You don't need to feel sorry for me, Doctor," he told her. "I really *do* enjoy being in space . . . being who I am. It's just—well, I'd like to be *able* to face other people. Even if I never do it. You understand what I'm trying to say?"

"I think so," she nodded. "You're trying to expand the edges of your life, to push yourself as far as you can go."

He grimaced. "Looks like I'm already there, doesn't it?"

"Nonsense!" Scharn snorted with a vehemence that surprised him. "You're a human being, Tomo. No human being yet has ever found his own limits."

Echoes of his own words to Max, Tomo thought. He'd believed them then; now, he wasn't so sure. "Um," he grunted noncommittally.

"I mean it. There'll always be new challenges for you—you'll see." Again her eyes shifted to the bio readouts, and when she spoke again her voice was back to its earlier quiet control. "I'm going to let you sleep, now; give your body time to throw off the rest of the sedative. If you want to talk again later, I'll be available. If not, that's fine, too."

Fatigue was indeed tugging at Tomo's eyelids, but with an effort he forced them open again. There was one question he still wanted to ask. "Dr. Scharn? Would you tell me what it's like being dirtside?"

He caught just the briefest half smile before his eyes closed again. "Mostly," Scharn said from the bottom of a long stairway, "it's very, very noisy."

Somehow, the answer seemed profound . . . but before Tomo could think about it, he was asleep.

Scharn turned off the viewer with a sigh, letting the professional calm evaporate from her face as the ache she really felt flooded in to take its place. Yes, Tomo would be able to return to his ship; a couple more days of biochemical analysis on him would conclusively prove what she already knew, that he wasn't drifting into psychosis. A small spurt of growth in his personality—true, in an unexpected direction—was really all that had happened, and in the controlled environment of starship travel there would be no stimuli to encourage further development. Like a teenager's

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grandiose dreams of his future, Tomo's thoughts of mingling with humanity would quietly fade and die. The mainter would be content with his world again; the company that owned him would be pleased and would return to business as usual.

Owned him. *Owned* him.

And something in Scharn snapped.

She thought about it for a long minute, and then traced a curve on the control ball. "Yes?" Iris answered.

"This is Dr. Scharn," the psychiatrist said firmly. "Get me the *Goldenrod*'s computer. I'd like to leave a private message for Tomo."

The *Goldenrod* launched on schedule, driving slightly out of the ecliptic plane and incidentally giving a grand view of Maigre in the rear viewer. "Well, that's it, Max," Tomo said, the deck feeling good beneath his feet. "Next stop, Canaan Under Vega. Docking equipment all secured?"

"Secured and shut down," the computer replied. "I'm running a check on deep-space functions, but so far everything registers normal."

"Good." Tomo watched the view of Maigre a moment longer, then picked up the cassette he'd earlier pulled out and placed by the control ball. He toyed with it, wondering if he really wanted to do this.

Max might have been reading his mind. "You don't have to try it yet, you know. Dr. Scharn made it clear this was to be strictly voluntary."

"I know," Tomo snapped, feeling the tension of this brand-new uncertainty and wishing Scharn had left things as they were. Almost wishing it, anyway . . . Abruptly, he jammed the cassette into the player and dropped into his lounge chair. "All right," he told Max, bracing himself. "Let's give it a try."

And suddenly there was someone else in the room with him.

Tomo stiffened as the stranger nodded pleasantly. "Hello, Tomo," he said . . . and from behind him a second man appeared . . . and a woman . . . and another man . . .

They vanished as abruptly as they'd appeared, and Tomo slumped in his chair. He could feel the sweat on his forehead, and even over the roar of the drive his heartbeat was audible. "I think," he said when his breathing was finally back to normal, "that those are the most realistic holograms I've ever seen. Uh . . . how'd I do?"

"Quite well," Max said. "Six point eight seconds. I'm sure you could have managed another few seconds, but the programmed cutoffs are very specific."

"Six point eight, eh?" Tomo repeated, trying hard not to let his disappointment show. "Well, I suppose I have to start somewhere. You think there's a chance I'll be ready by the time we reach Canaan Under Vega?"

"I really don't know," was Max's diplomatic reply. "But we have ten point four years to find out."

Tomo smiled and resettled himself in the seat. "We sure do. Okay; let's try it again."

The dirtsiders at Canaan Under Vega were going to be very surprised. ■

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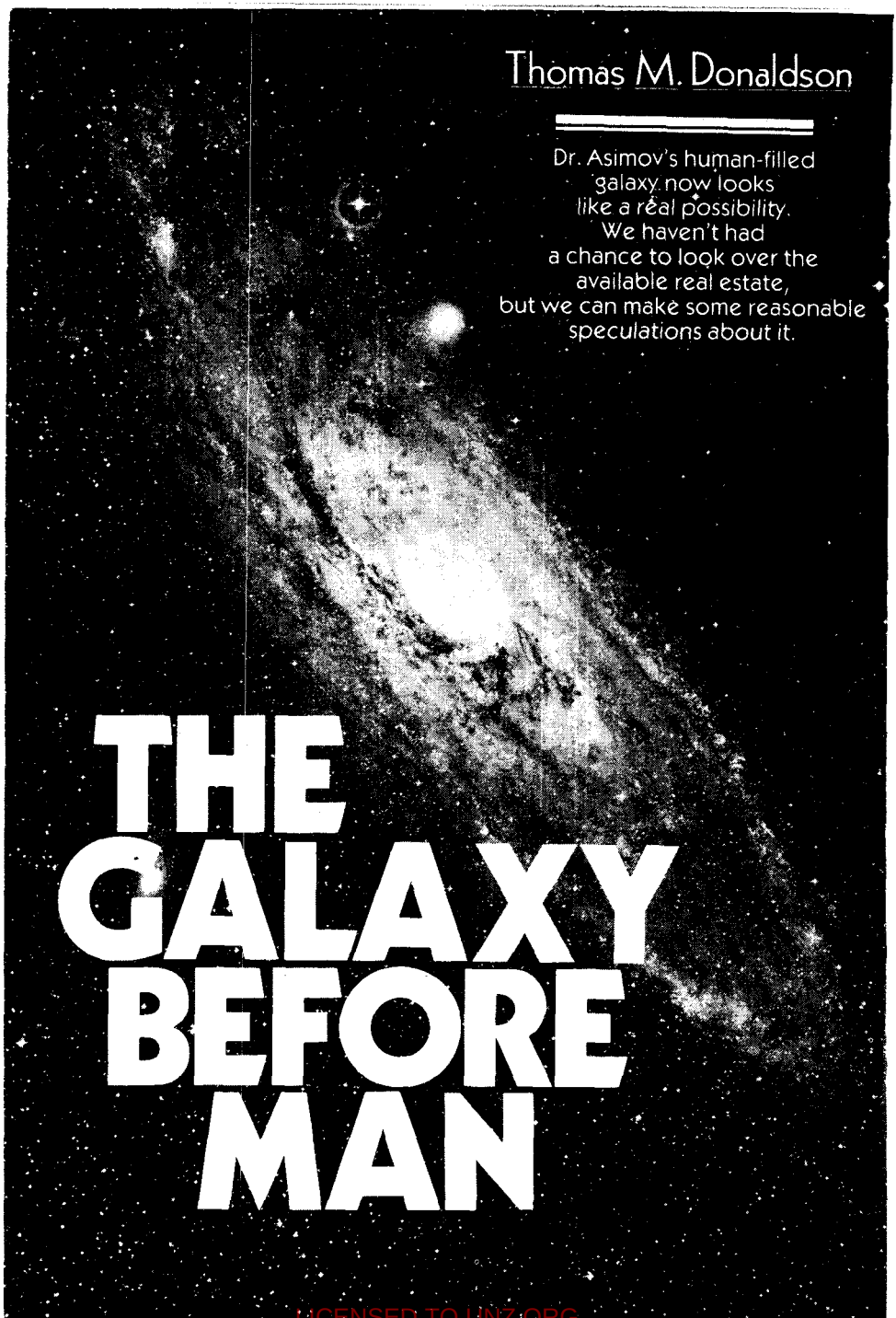
Thomas M. Donaldson
Dr. Asimov's human-filled galaxy now looks like a real possibility. We haven't had a chance to look over the available real estate, but we can make some reasonable speculations about it.
THE GALAXY BEFORE MAN

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Two million years ago, our early forebears set out to explore and colonize the Galaxy. In many ways they were primitives, but their spaceships could travel almost as fast as our own. They colonized in small bands: whenever one group felt for any reason that it might do better elsewhere, its members joined together, built a spaceship or bought one, and set out into the Unknown. We cannot travel much faster than they, but we can travel more safely: many of these attempts at colonization failed, either because they landed on inhospitable planets or for some other reason, since they were never heard from again.

By now the Galaxy has been altered by human habitation. We are controlling the formation of new stars and have begun to change their orbits. We rarely travel to other stars by rocket, since acceleration by laser beam allows much higher velocities. Many of you may not be old enough to remember what the Galaxies were like in those days. Even I myself was young one million years ago, when on all our radio links to other stars the word came that there were no longer any systems in the Galaxy uninhabited by man; and people began to dream of what had happened, or would happen, to colonists who set out for Andromeda.

What kind of Galaxy did the first humans find? What were the planets and stars like, before they had been altered by Man?

Of course we don't know the answer to this question, because we haven't yet colonized Alpha Centauri or even the Moon. But as scientific ideas about the Galaxy improve, so do our estimates of what it will be like. Twenty years ago Stephen Dole wrote *Habitable Planets for Man* to work out a well-founded guess for the number of habitable planets in the Galaxy (600 million). What's our best guess now for an answer to the historian's question?

1. Compared to 20 years ago, astronomers now have a better idea of the structure of the Galactic nucleus and the overall structure of the Galaxy.

2. Some quite recent discoveries about the chemical history of the Galactic disk tell us more clearly just how the content of heavy elements in stars varies according to their position in the Galaxy. These discoveries change our ideas about location and likelihood of habitable planets.

3. Reasonable definitions of what is a habitable planet or solar system have changed, particularly since O'Neill and others explained just how simple it is to create artificial habitats in space. Furthermore, we know a lot more about terraforming, how to *create* habitable planets where none were before.

4. Current best estimates of the boundaries of the *ecosphere*, the region within which habitable planets can exist, make it far narrower than previously believed, and even within the ecosphere only a very limited range of planetary masses can support life. On the positive side, better ideas about what determines a planet's climate improve our ideas about likely characteristics of all planets, habitable or not.

What do these advances mean for our current "best guess" about the Galaxy before man?

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The Large-Scale Nature of the Galaxy

Actually, current estimates of the mass of the Galaxy make it at least 5 times more massive than visible stars, gas, or dust can explain. No one knows what makes up this "Missing Mass": theorists have proposed neutrinos, dark planets, or black holes. Total Galactic mass is about 1 trillion solar masses, distributed spherically, with the visible, luminous spiral Galaxy cutting the sphere into two hemispheres. Someday people will *use* this dark matter, and colonizing expeditions to new stars will arrive equipped to create solid matter if they don't happen to find any. Until then, however, colonists will need planets in the systems they settle. What will they find near the star systems upon their approach?

Without elements heavier than hydrogen or helium, no planets can form. How much of these necessary ingredients do stars have? Astronomers call the percentage of heavy elements in a star the *metallicity* of the star. The Sun has a metallicity of about 1% by mass; comparing all stars to the Sun, I'll call this a metallicity of one.

Most stars don't have a metallicity of 1.0, like the Sun. Moreover it turns out that levels of *metallicity* and stellar age vary according to distinct patterns in both disk and globular cluster stars. Metallicity changes with both *location* and *age*. Measuring the exact strength of stellar spectral lines even lets us estimate the ages of individual stars. Since planets need heavy elements, then to find out about planets, where they are and how many, we should first look at how metallicity varies for stars.

Stars in the Galaxy divide naturally into three different classes. The first of these is the *spheroidal component*, stars lying in a spheroidal region centered at the Galactic Center, usually in highly eccentric orbits. Spheroidal component stars are old, with ages ranging from about 15 billion years down to 10 billion years (by comparison, the age of the Sun is 4.6 billion years). They have low masses, about .8 times the mass of the Sun; almost all are therefore reddish K or M type stars. More massive stars of the same age have all burned out into white dwarfs. They have very low metallicities, from as low as 0.1% up to as high as 10% of the Sun's metallicity. Their metallicity increases the closer their orbits lie to the Galactic Center. Their total mass is between 2 billion and 9 billion times the mass of the Sun.

Globular clusters are clusters of spheroidal component stars. Globular clusters lie scattered in a spherical region extending out as far as 100,000 parsecs from the Center, with density increasing toward the Center. Their metallicities can go as high as 10% that of the Sun. Their total mass, out to a radius of 20,000 parsecs (two times the distance of the Sun from the Galactic Center) is about 90 million Solar masses. Individual globular clusters contain, on average, about 250,000 stars.

The second class of stars is the *nuclear bulge stars* in the Galactic Center. These stars are just as old as the spheroidal component stars, 10 to 15 billion years, but richer in heavy elements. They may have metallicities as much as *two times* that of the Sun. Nobody has

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seen the Center: astronomers infer what it is like by comparison with other galaxies such as Andromeda. Its density is very high; the central one parsec may contain six million Solar masses, and the inner 50 parsecs 500 million.

The closer their orbits lie to the Center, the more spheroidal component stars resemble nuclear bulge stars. The old term, *population II stars*, includes both kinds.

Finally there are *disk* stars, or *population I* stars. Disk stars are much younger, with ages from about 10 billion years down to stars forming right now: metallicity in disk stars varies with both age and position.

First, for stars in the disk *of equal age* metallicity goes down from the Center out to the Rim. Metallicity also goes down as we move vertically up out of the Galactic plane. The Sun is close to the Galactic plane and about midway from the Center to the Rim (see Figure 3). Outward from the Sun the decrease is approximately linear in both cases; metallicity decreases by a factor of two or three for every 10,000 parsecs outward from the Center and a factor of three for every 1000 parsecs up or down out of the Galactic plane. Toward the Rim metallicity decreases even faster; extreme Rim stars have metallicities only 10% of the Sun's.

These differences in metallicity are for *disk* stars of *equal age*. But metallicity changes with age too. Older stars have lower metallicity. What ranges of ages do we get for disk stars near the Sun? To look closely at metallicity and its dependence on age we really need a table. See Table 1: Population I Stars,

Table 1: Population I Stars
Average metallicity of Population I stars in relation to age, and proportion of the total number of stars of a given age.

Age of star (Billions of years)	% of stars of given age	Average Metallicity of star (Sun = 1.00)
0.0-0.9	3.6	1.02-1.5
1.0-1.9	3.4	1.09
2.0-2.9	3.0	1.07
3.0-3.9	3.4	1.00
4.0-4.9	3.8	.93
5.0-5.9	6.5	.85
6.0-6.9	8.7	.77
7.0-7.9	10.6	.67
8.0-8.9	11.0	.57
9.0-9.9	11.1	.46
10.0-10.9	9.3	.42
>12.0	7.5	.28
(The age of the Sun	*is 4.6 billion years)*	

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Table 2: Population II Stars

Metallicity of spheroidal component (SC) stars of Population II in relation to age, and proportion of the total number of a given age.

Age of star (Billions of years)	% of total SC stars of given age	Metallicity (Sun = 1.00)
10.0-11.7	16.3	.10
11.7-13.5	38.1	.01
13.5-15.0	45.5	.001

Metallicity of nuclear bulge (NB) stars of Population II in relation to age, and proportion of total number of a given age. (This table is conjecture).

Age of star (Billions of years)	% of total NB stars of given age	Metallicity (Sun = 1.00)
10.0-11.7	16.3	2.0
11.7-13.5	38.1	1.0
13.5-15.0	45.5	0.1

Both tables lack accuracy compared to Table 1. The table for SC stars is calculated from work on ages and metallicity of globular clusters. The table for NB stars is a reasonable conjecture only.

and its companion, Table 2: Population II Stars.

What do these tables mean for any solar systems found by the first colonists? We're going to talk here about the *statistics* of planetary systems. Theories of planetary formation today still aren't exact, so we need some reasonable speculative assumptions. First, I SHALL ASSUME HERE that virtually all stars will form SOME planets if the materials (heavy elements) are there; right now, from a sample of *one* we find *one* star with planets: 100%; it seems much more likely that planets are very common than that they are rare. Some

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scientists do speculate that very bright stars with spectral types O, B, or A, like Sirius or Vega, don't form planets; however O, B, or A stars make up less than 1% of all stars. They're pretty, but they don't affect our statistics. Secondly, I SHALL ALSO ASSUME that the mass of an average "earthlike" planet is *proportional* to the metallicity of its star compared to that of the Sun. This means that stars of metallicity .50 would then (on average) have planets *half* as massive as the Earth in the same locations. Fundamentally, metallicity SHOULD affect formation of planets; the fewer materials (heavy elements) available, the smaller a terrestrial planet should be. Supposing that average planet mass is proportional to metallicity of the star seems the simplest relation between them, and a reasonable first guess.

Assuming this, planets of the farthest Rim stars would be, on average, only about 1/10th as massive as the Earth, or about the mass of Mars. Planets of stars in toward the Nucleus will be correspondingly twice as massive as the Earth. Again, since metallicity decreases sharply out of the Galactic plane, at a height of about 1000 parsecs vertically up from the Galactic plane (comparatively quite near the Sun) average "Earthlike" planets will have a mass about 1/3rd that of the Earth. The Sun is close to the Galactic plane; *really* Earthlike planets should almost never occur near the Rim, nor will they occur far from the Galactic plane.

That was for disk stars. For *spheroidal component* stars the biggest inference from these assumptions is that they WILL have planets, even if only small ones. Globular cluster stars with particularly high metallicities of 10% of the Solar might even have planets as massive as Mars! Even stars with metallicities of only 1% or .1% would have *some* planetary matter: the Moon has about 1.2% of the mass of the Earth; Population II stars of 1% metallicity could support planets as large as the Moon, and even Population II stars of lowest metallicity would have some quite large asteroids.

Finally, Table 1 tells us remarkable facts about star ages. Almost 50% of the disk stars are older than seven billion years, close to twice the age of the Solar System. Although they're very old solar systems they shouldn't contain very Earthlike planets, since metallicity, and therefore planetary masses, range from about 2/3rds that of Earth down to less than 1/3rd that of Earth. The Sun is slightly more metal-rich than average for stars of its age. From Tables 1 and 2 we see that, even though planetary matter may be common, and opportunities for settlement by a truly spacefaring people good, planets like the Earth will be quite rare. We begin to wonder particularly whether *any* of these old planets and solar systems can contain life. For better answers to this question we'll have to look more closely at the variety of planets we can expect to find.

Life Zones and Planetary Climatology

The *life zone* about a star is the region within which an Earthlike planet can exist. However, rather than simply trying to estimate the number of planets with a completely Earthlike climate and ecol-

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ogy (ie. "shirtsleeve" habitability), I'm going to use current knowledge about the *general* climatology of planets and the history of life on Earth to speculate about general planetology in other solar systems. Since 1960 the Pioneer and Voyager flights have told us a lot about planetary climates, particularly the climates of the inner dwarf planets. Hart, Rasool, deBergh, and others have also developed much better theory on the likely evolution of atmosphere and climate on Mars, Venus, and Earth.

The single major factor determining a planetary climate is the phase diagram of water: is it ice, liquid, or vapor on the planet's surface? If too much water exists as vapor, a greenhouse effect raises the planet's temperature even more. Sunlight dissociates the water vapor in the upper atmosphere, and the hydrogen then escapes, leaving a very hot, extremely dry planet just like Venus today. Moreover all of these things happen within 500 million years of the planet's formation. If liquid water can exist on the planet's surface, almost all the carbon dioxide originally in its atmosphere dissolves, combining with rocks to form limestones. Nitrogen dominates its atmosphere rather than CO_2, and life will probably form if the planet stays at the same temperature long enough. Furthermore, water dissolved in the crustal rocks increases their fluidity, producing plate tectonics as on Earth. If only ice can exist on the surface, then the planet remains cold, without life, with no H_2O-caused greenhouse effect: much like Mars. Finally, of course, the planet may be like the Moon, simply too small to have an atmosphere.

Michael Hart has done the most thorough calculations of the exact development of an "Earthlike" planet at different distances from its sun. He finds that planets of the same mass as the Earth but with an orbital radius of only .95 AU would develop a runaway greenhouse effect early in their history, while planets only 1.01 times farther from their sun would develop life; but then as photosynthesis increased the oxygen levels in their atmospheres, they would lose their greenhouse effect, icing over completely after only 2 billion years, at half the age of the Earth. Moreover, planets which ice over never reverse their ice age to warm up again, even though their suns do gradually burn brighter with age.

Even Earth will lose its habitability long before the Sun goes out; other scientists point out that the slow increase in brightness of the Sun should eventually heat up the Earth too much, finally causing a runaway greenhouse effect. Oceans would vaporize and dissociate. CO_2 now in limestone would return to the atmosphere, making a planet like Venus except for its past history. Some estimate that this event will occur in only 100 million years' time. This means another class of planet too: the *postbiotic* planet, which once had extensive life but now does not.

We can distinguish a total of seven different classes of *inner* planet interstellar colonists might find; I summarize these classes in Box 1. They range from the planets like Venus to planets like Mars, and some types not present in the Solar System. Box 1 describes inner

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solar systems only. As yet we don't really know enough to make a good classification for outer planets. Besides Jovian gas giants and ice worlds such as Ganymede, we might have planets large enough to retain an atmosphere but small enough to have solid surfaces, rather like Titan. They would probably have mainly nitrogen atmospheres, with either methane or ammonia in large amounts (maybe liquid), and planetary crusts of mixed ice and rock.

Box 1: Classes of Inner Planets

Class 1: Venuslike. Hot and dry due to loss of water; dense atmosphere of CO_2. Water never existed in liquid form.

Class 2: Earthlike and prebiotic. Water in liquid form. CO_2 combines with crustal rocks to produce limestones, atmosphere of nitrogen, CO_2, methane, with some ammonia.

Class 3: Iced-over. Most planets of Class 2 evolve into planets of Class 3 after about 2 billion years. Crustal rocks high in limestone, atmosphere of nitrogen and CO_2, water in the form of ice only.

Class 4: Earthlike and habitable. Water in liquid form, with oxygen a major constituent of the atmosphere. Geology similar to that of Class 2, with an extensive ecology and long history.

Class 5: Postbiotic. After a long period of liquid water and life, the planet underwent a runaway greenhouse. CO_2 comes out of combination with rocks; planets like those of Class 1 except for paleontology.

Class 6: Marslike. Planet never developed liquid water; atmosphere largely of CO_2.

Class 7: Moonlike. Too small to develop a significant atmosphere, geologically "dead" after about 1.5 billion years.

Published studies consider planets of mass equal to Earth. To estimate how climate varies with mass, we notice that the greenhouse effect depends on the *total mass* of CO_2 and H_2O, while the *pressure*, and hence the boiling point of water, depends on the *weight* of atmosphere, hence on surface gravity. Smaller planets with smaller surface gravity therefore could have larger greenhouse effects and life zones farther from their suns, while the reverse happens for a larger planet. Since we'll need some numbers, as an estimate only I SHALL SUPPOSE that an increase in surface gravity by 1.01 corresponds exactly to an increase in orbital radius of 1.01, and similarly for a decrease. Using some reasonable estimates of maximum and minimum orbital distances for different kinds of planet, we then get a diagram, Figure 1, summarizing relations between distance from its sun, mass of planet, and planetary type.

To find out how many planets of each type there are, we need to consider the *age* and *position* of their star (since these affect metallicity) and its *spectral type*

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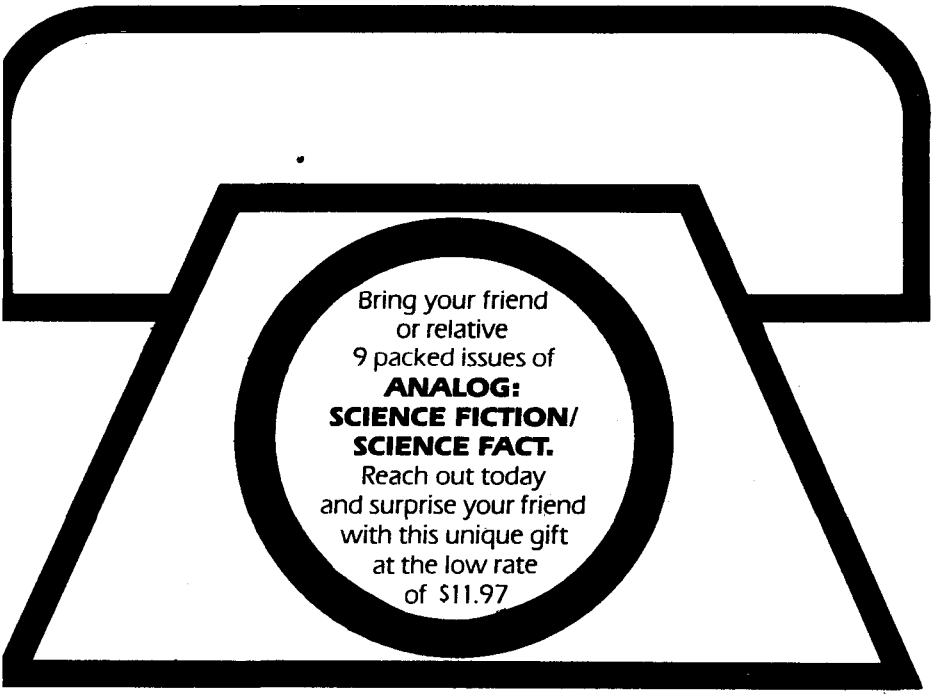

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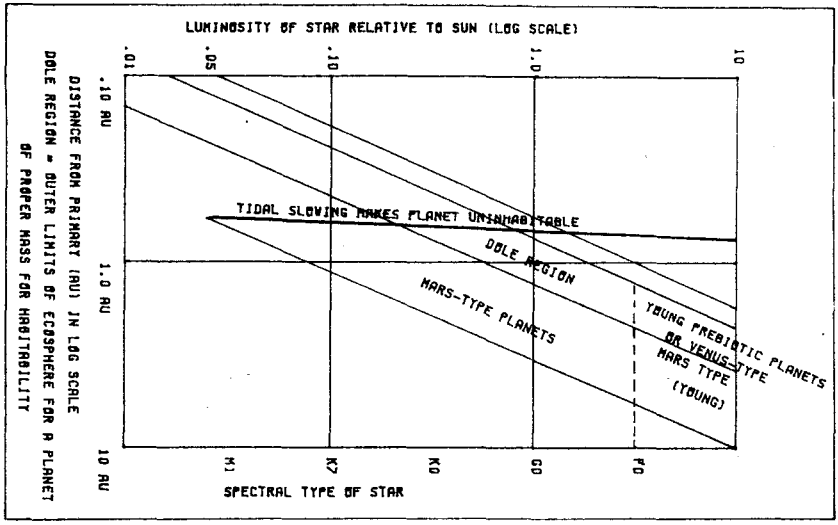

Figure 1: Masses, Solar Distance, and Type of Planets

This diagram shows the relation between the masses of planets, their distance from their central star, and the geophysical type which they will develop. Of course it is approximate only. The notable facts are: the broad and wide area containing Mars-like planets and the relation between mass and distance controlling the Earthlike planets.

(which affects the orbital widths available to hold planets of each type). For G0 stars like the Sun, we'll suppose that the number of planets of each class varies in proportion to the area for that class in Figure 1; if the star is G0 but much older than the Sun, it should have more Moonlike planets and fewer large ones. We can then calculate the two columns of Table Number 3. Stars *younger* than the Sun will have similar numbers of Venus and Marslike planets, but rather than the "Earthlike" planets we will have *prebiotic* planets, too young for abundant complex life, with atmospheres low in oxygen and high in methane and CO_2. Stars younger than about 2 billion years will also have (future) iced-over planets, looking just like prebiotic planets, but on the way to early extinction.

What about stars of other spectral types than G0? The width of its "life zone" varies in proportion to the star's luminosity, and as Dole pointed out, tidal effects forbid habitable planets for stars of less than about .7 solar mass. The zone of Earthlike planets in Figure 1 therefore squeezes down as mass of the central star decreases, until it van-

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ishes; the zone for Venus-type planets narrows down too. Figure 2 shows these regions as they vary with spectral type of the star; it says that "habitable" planets can only exist from Spectral Classes G down to K1, but the spectral classes for which Mars-type *terraformable* planets can exist take in all the stars of Spectral Class K and even some of Spectral Class M.

These tables tell us that MARS-TYPE PLANETS ARE VERY COMMON. Almost every solar system of a G0-type star will have at least one Mars-type planet. Many will have two. Rim stars of low metallicity will have Mars-type

Table 3: Frequency and Type of Planets

This table gives the frequency and type of planets for a G0 STAR.

Class of planet	Frequency of planet Percent of systems with planet of the class	(star of Solar age) Number of systems with type for every one with an "Earth"
Venus-type	20.5	9.52
Earth-type(*)	2.16(*)	1.0
Iced-over	7.9	3.66
Marslike	69.0	32.0
Moonlike	1.0	.5
Class of planet	**Frequency of planet** **% of systems with planet of the class**	**(star age 7 gigayrs)** **No. of systems with type for every one with an "Earth"**
Venus-type	10.2	9.52
Earth-type*	1.08*	1.0
Iced-over	4.0	3.66
Marslike	34.9	32.0
Moonlike	50.0	49.0

* All planets of "Earthlike" type in a solar system of age greater than about 4.7 billion years will be *postbiotic*, all their life extinct. "Earthlike" planets younger than about 3.7 billion years would have too little oxygen in their atmospheres for habitability.

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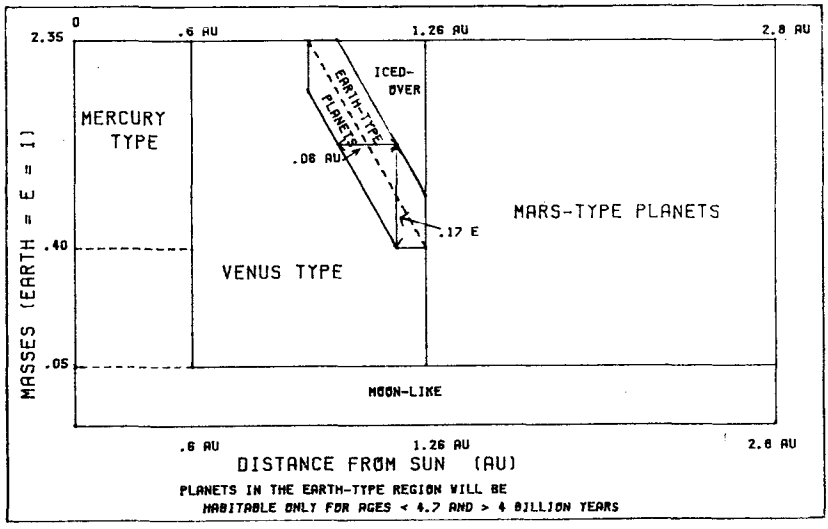
planets. Even very old stars, too old for habitable planets of their own, will still have Mars-type planets, and even stars of spectral types down to type M (faint red dwarf stars) will have a "Mars-type" zone large enough for at least one Marslike planet. After calculations we find that fully *15 percent* of all stars should have at least one Mars-type planet, compared to *less than .002 percent* of all stars having a habitable planet.

Furthermore these tables tell us, qualitatively, just what solar systems of *older* stars would be like. The *number* of planetary bodies resembles that of the Sun, but lower metallicities mean that many more of these bodies would be small, like the Moon. About 1% of such solar systems would contain extinct, postbiotic planets. Colonists to such a system would eventually send expeditions to the surface of such planets to do paleontology; surface conditions would be like Venus, with dense CO_2 atmospheres, but fossil life everywhere. In particular Table 1 tells us that only about 3.8% of all stars lie in age ranges old enough, but not too old, for complex life such as that on Earth.

Figure 2: Type of Planet and Spectral Type of Star

Note the extensive area containing Mars-type planets, particularly how they are possible for stars of spectral type much redder than that of the Sun, all the way down to M type (the very red stars). Were it not that stars of types F and A were so rare compared to the types of G and below, the wide ranges of terraformable planets for these stars could be quite important.



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Even though Mars-type planets are overwhelmingly common, planets like the Earth, old enough for complex life and an oxygen atmosphere, are very rare indeed. Because of the age effect (that the range of ages within which complex life can exist is quite narrow), the metallicity needed for an Earthlike planet, and the dramatic narrowing of the ecosphere, our estimates for likelihood of "Earthlike" planets have decreased dramatically, to less than .002% of all stars. In particular, the nearest "Earthlike" planet, immediately habitable, is probably more than 200 LY from the Earth; at a velocity of .1c we would need a *minimum* of 2000 years to reach it. Very likely humanity will have founded many colonies, and actively traveled the stars for several thousand years, before human crews land on a planet with its own native complex life.

Of all planetary types within the Solar System, however, Mars comes closest to one we can easily modify into a planet MADE habitable. All we need is a suitable heat source and a source for volatiles to make an atmosphere. Table 3 therefore means that 15% of all stars, from spectral types M0 on up to F0, will someday have one *terraformed* "Earthlike" planet. Such planets will have geologies like Mars, few ore bodies, and no plate tectonics, but extensive oceans and "Earthlike" weather. Rather than *native*, typical life forms on human-colonized planets will be life come from Earth, long ago: oak trees, pines, grasses, lilacs, mahogany, roses. . . . After a few hundred thousand years, of course, Earth life would evolve to meet its new conditions; strange ecologies might develop from unrepresentative collections of species brought by the first colonists.

Terraforming would happen slowly. In particular, no one yet knows how to terraform a planet in less than several hundred years. Whole nations could begin and last through a long history: the prehistory of a solar system, before terraforming, while colonists founded and lived extensively in space habitats throughout their system.

Galactic Planetology and Climate

As yet we haven't traveled to the solar system of even one star other than our own, so we don't know how solar systems may differ from one Galactic region to another. But different Galactic regions differ a lot, chemically and physically, all of which suggests speculations. Not one is even as well founded as our ideas on climate of the inner planets.

First, a lot of evidence suggests that Galactic regions differ chemically. Besides very well established differences in metallicity, the exact composition in elements may change. Nitrogen increases about twice as rapidly as oxygen when we approch the Nucleus. Average "Earthlike" planets closer to the Center might have atmospheres twice as high in nitrogen and ammonia. Other chemical elements may differ also.

Second, approaching the Center, stellar density increases, tripling (on average) for every 3000 to 5000 parsecs inward. Density increases sharply at the Center itself; stars in the Center are as close as 6 light-days to one another. Increasing density must cause increasing effects on planetology. In the Center

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itself close stellar encounters must happen often; even without outright collisions, close encounters will disrupt planetary systems. At the central 100 parsecs itself, planetary systems will evaporate and the planets take up orbits in interstellar space. When density falls to average stellar distances of several light-months, planetary systems would survive, but outer planets would take up erratic orbits and might leave the system entirely. As density decreases still more, planets could keep their orbits; but relatively high stellar density might affect *climates* and physical conditions on such planets. In particular, disk stars closer to the Center exist amid continuous star formation, with young, massive O-type stars often nearby. When O-type stars go supernova, they will alter climates on any planets of systems nearby.

Quantitatively, tidal disruption turns out the most significant. Let's suppose that planetary systems of both stars will disrupt if two stars pass at a distance of less than one light-day. Knowing the relative velocities of the stars, we can calculate the density of a star field needed to disrupt a solar system. To get a rough idea I shall assume that the average velocity of stars with respect to one another in the *disk* or *globular clusters* is 20 km/sec, and in the Nucleus is 175 km/sec. These are about the current values for these locations (Mihalas p. 456, Oort). The number of stars in the cyclinder of radius 1 LD swept out by

Box 2: Classes of Outer Planets

Since our exploration of the outer Solar System is not so complete as our exploration of the inner, this table is much more conjectural. In particular, these classes are likely to differentiate *much* further as we learn more. Saturn must differ significantly from Jupiter, and the exact planetology of a Titan-type planet will probably depend on its solar distance and the chemistry of its atmosphere.

Class 1: (Jovian gas giant). Massive low density planet with greater than 4 times the mass of the Earth (this is a critical mass which, if exceeded, will accumulate hydrogen and become still more massive). Hydrogen and helium major atmospheric constituents. Masses of 10 to 1000 times that of Earth.

Class 2: (Titan-type). Planet of mass less than 4 times that of Earth. Ice a major crustal component; atmosphere of nitrogen with trace organic chemicals. Depending on distance from its sun, these planets may have large amounts of liquid ammonia or liquid methane in "oceans." Since ice is weak, surfaces will have low relief; large bodies of liquid water may exist kilometers under the ice.

Class 3: (Ganymede). Planet of mass too small to hold an atmosphere. Ice a major crustal component, with cratering but very low relief. Liquid water underneath the ice.

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the star in its lifetime then gives us the number of encounters.

Close star encounters happen very rarely at the density of the Galaxy near the Sun; about one star in 25000 has an encounter in a lifetime of 10 billion years (less, in fact, since these rough figures give an overestimate!). On the other hand, stars near the Galactic Center get almost the reverse: average stars at the Center, where star density is as high as 15 million per cubic parsec, undergo *over 27,000* close encounters with other stars in a lifetime of 10 billion years. Outward from the Galactic Center, density decreases; at 3 to 5000 parsecs from the Center, density falls to about 5 times the solar neighborhood; about one star in every 5000 would have had its planetary system disrupted by close encounters. Globular clusters are much denser than the solar neighborhood, from 1000 to 100,000 times the star density of stars near the Sun. Average globular clusters might have as many as one star in every 25 divested of planets, while in the densest clusters less than four stars would have kept their planets.

Besides outright destruction, close encounters would change planetary orbits. We can call a solar system "severely perturbed" if the planets all follow highly eccentric orbits at high angles to the plane of solar rotation, rather like the traditional picture of electrons in an atom. If encounters as close as two light-days will severely perturb planetary orbits, we find about eight stars in every 25000 with perturbed systems near the Sun, and for average globular clusters almost 10% of systems. For the denser globular clusters, perturbed systems would be normal. Tidal effects of course vary in degree; most planets of stars in a globular cluster would have eccentric orbits at high angles to one another.

As a matter of interest, the Solar System itself probably had an encounter close enough to perturb the orbits of Neptune and Pluto and cause extensive meteor bombardment, early in its history.

Nearby supernovas give us a second effect. Even though they mean little for a planet not otherwise habitable, they *should* mean catastrophe for the ecosystems of any habitable planet. However, even though the Sun should have passed close to several supernovas in its lifetime, no one has found firm paleontological evidence that any such catastrophe ever happened. One recent survey found excellent evidence for large asteroid impacts on the Earth within the last 500 million years, but none at all for catastrophic supernovas.

I cannot believe that supernovas would *never* cause catastrophes. If we suppose about one supernova in every 500 million years happens close enough to cause catastrophe in the Solar neighborhood, then at about 3000 parsecs from the Center, with density five times greater, habitable planets would experience five such catastrophes in their history, *in addition* to the normal quota of ice ages, asteroid impacts, and so on. This gives about one mass extinction every 70 million years, compared to Earth's record of one per 200 million years. I think it unlikely that any such planet could develop intelligent life

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forms. Our simian ancestors, for instance, would have perished long before we evolved. Habitable planets less than 3000 to 4000 parsecs from the Galactic Center would have geological histories of catastrophe and no intelligent life.

The Galaxy Settled by Man

We've now got a reasonable approximation to the Galaxy first encountered by human colonists. What societies and stories would grow up in the first million years of Galactic settlement? How would people live in the Galaxy settled by man?

Table 4: Relative Abundances of Main-Sequence Stars by Type

This table describes the relative numbers of stars of different spectral types *in the solar neighborhood.* Near the Galactic Center, there should be many more stars of classes K and M.

Spectral Class	Mass (Sun = 1)	Percent of stars (Solar neighborhood)
O	32.0	.000016
B	6.0	.09
A	2.0	.58
F	1.25	2.90
G	0.9	7.31
K	0.6	15.09
M	0.22	73.25

This table is taken from Dole (p. 86). As explained in the text, ALL the stars of Spectral Class K and stars of Spectral Classes M0 and M1 have luminosities sufficient to permit *terraformable* planets in their system. We have:

% OF STARS OF SOLAR AGE WITH TERRAFORMABLE PLANETS: about 15%

% OF STARS OF SOLAR AGE WITH "EARTHLIKE" PLANETS: less than .0015%

First, most settled solar systems will NOT belong to G-type stars. From Table 4 we see that G stars make up only 7% of all stars. M-type stars are overwhelmingly common, and will harbor most civilizations.

Civilizations of each solar system would all center on space travel and space habitats: they would first settle the

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moons and asteroids of their system, and only hundreds of years later terraform the (on average) one or two planets allowing that. Since all ores and minerals on which our own industrial civilization depends formed on Earth because of abundant liquid water, human civilizations of other stars would use large industrial operations, nuclear blasting, and asteroid capture in interplanetary space for metals and other materials. Even terraformed planets in their system would keep geologies quite different from Earth's, without limestone rocks or plate tectonics, until millions of years had passed.

They would keep frequent radio contact with other systems, but communication would take a long time. Languages evolve in only 1000 years; messages from 1000 LY away would need translation. Cultural differences would increase with distance; most systems would be independent, harboring several nation-states, but each such state would differ little from others in its system. People would learn by radio of events thousands of LYs away, but distant information would come from the more and more remote past, filtered through many different translators of many languages and cultures. History therefore would not form a linear story, but expand with time as the light-cone expands. You would find in your libraries records of 27 million civilizations of 1000 years ago, and eight times that for 2000 years ago.

Interstellar travel would cost very much and take a long time, even by standards of spacefaring civilizations. People would travel to other systems, but travelers would be rare wonders to everyone else. Interstellar travel, of course, is much more a problem of biology than physics. People would live for thousands and finally millions of years, and interstellar journeys would be small fractions of a lifespan; but it would still take a long time, and many other activities would be more interesting in comparison. *Trade*, however, could take place, in objects of highly concentrated value: curios from other civilizations, valuable antiques, and collectors items. Wealthy collectors would closely guard their few strange coins or microfilms from other civilizations thousands of light years away (and so now from the remote past). At the same time, *copies* of even large objects from other stars; music, pictures, and films would exist everywhere, a vast wealth of relics from other civilizations, but those from far away would seem even more remote than Egypt or Sumer to us.

In globular clusters and multiple star systems, with star densities much higher than normal, travel between stars could happen more frequently, producing more cultural unity.

For *globular clusters* star densities average about 400 stars per cubic parsec; stars in globular clusters have nearest companions about five light months away. Even at 10% of light speed that is only five years journey away, as far in time as the opposite side of the Earth was 400 years ago. Solar systems in globular clusters would only have planets like the Moon or the asteroids, occasionally the rare planet as large as Mars; people living in such systems would

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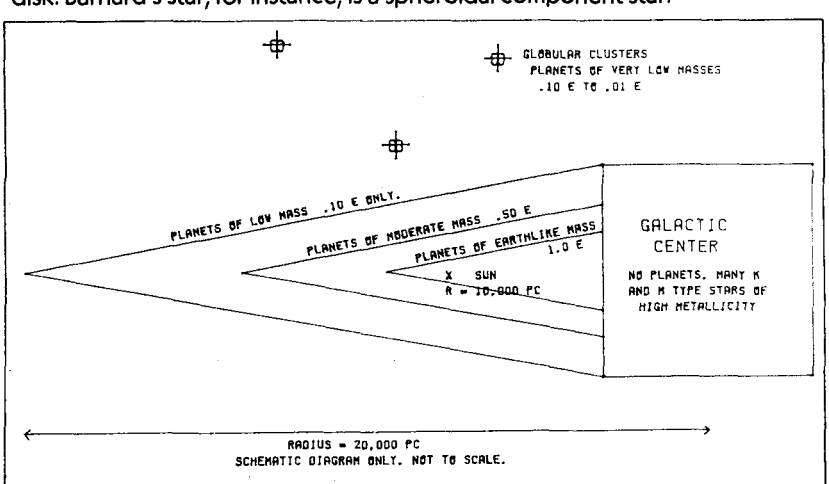
therefore never have lived on even an artificially "Earthlike" planet. On the other hand, the low percentage of heavy elements means large amounts of *hydrogen*, and therefore of energy; solar systems in globular clusters would have 10 times the amount of energy per person and therefore could afford interstellar journeys at three times higher velocity. Nearest stars would be less than two years journey away, and travelers could reach 400 stars all within a travel time of about 10 years. People could transport actual paintings or small pieces of furniture from star to star for trade; people who had, in their recent life, traveled to another system could be 20 times more common. Globular clusters differ from other parts of the Galaxy in another way, too: they tend to lie outside the plane of the Galaxy. They will only have been settled hundreds of thousands of years from now, and at such distances from the rest of the Gal-

Figure 3:
The Galaxy Before Man
Figure A

These two figures sum up the Galaxy before Man. I have shown the regions of the Galaxy and the kinds of planets we will find in them. This is the *physical geography* of the Galaxy, and for a Galactic civilization it would mean the same things that the Earth's physical geography means for us: that Bedouins will live in deserts and wet rice farmers in the tropics.
The major fact which cannot show on this diagram is the difference between Population II (spheroidal component) stars of low metallicity and Population I stars of high metallicity, since these types are distributed throughout the disk. Barnard's star, for instance, is a spheroidal component star.



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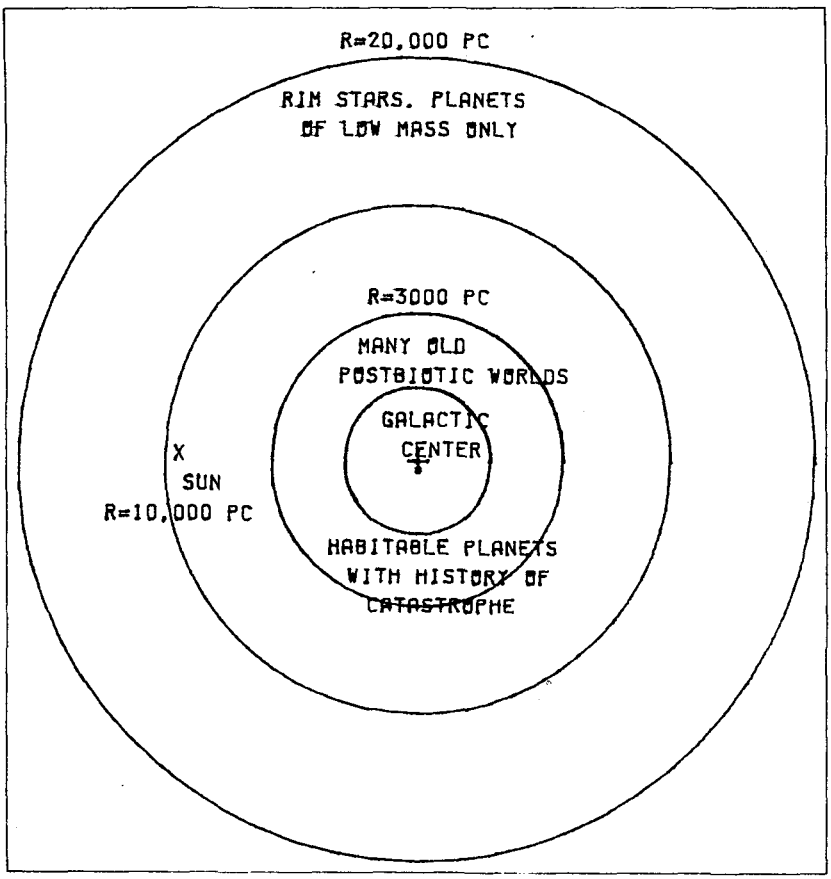
axy human cultures there would diverge not by thousands but tens of thousands

Figure B



of years from others elsewhere. Because they were energy rich, their peoples might undertake even longer journeys outside the Galaxy; settlement of the Magellanic Clouds might ultimately stem from people of globular clusters.

A second (and rather interesting) location for frequent interstellar travel are *multiple star systems*. These are simply solar systems containing 6 or more stars, gravitationally bound, at distances on the order of 1000 AU or less. Batten estimates the number of systems containing 6 or more stars at .2% of the

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total number of stars; the total mass of stars in such systems must equal the total mass of stars in globular clusters! A multiple star system, of course, could consist of more than one system of planets. Such systems would have average metallicity for their neighborhood, and therefore average costs of energy. But travel between stars of such a system would take only a few months at most, giving very extensive trade and political relations, long histories of rivalry, trade, invasions, alliances. With an average of 6 times the population of single systems, they might have much more cultural sophistication, just as cities contain more cultural opportunities than small towns.

Other Galactic regions would not distinguish themselves by easy travel but by different physical factors. *Open star clusters* are not much denser than the general star field; in the Pleiades the nearest stars lie about 2.5 light years away, still a long journey. But stars of open clusters differ from stars elsewhere by their youth: many systems would have only recently formed, with many more asteroids and planetary bodies than elsewhere. Civilizations settling about such systems would center much more than others on space habitats and asteroid mining; to spacefaring people they might seem rich in resources. Many Population II stars follow orbits in the disk; colonists in such systems would find only small planets, but would have 10 times the available energy compared to people of younger systems, and might trade extensively to other stars. Finally, there may be many dark bodies in interstellar space, as large as Jupiter and as close as one LY to the Solar System. Such systems would be small, but could support 100 million people, using nuclear fusion for power, at a high physical standard of living, in isolation from all others. Such people would be, in the Galaxy settled by man, like the islanders of Tristan de Cunha today. ■

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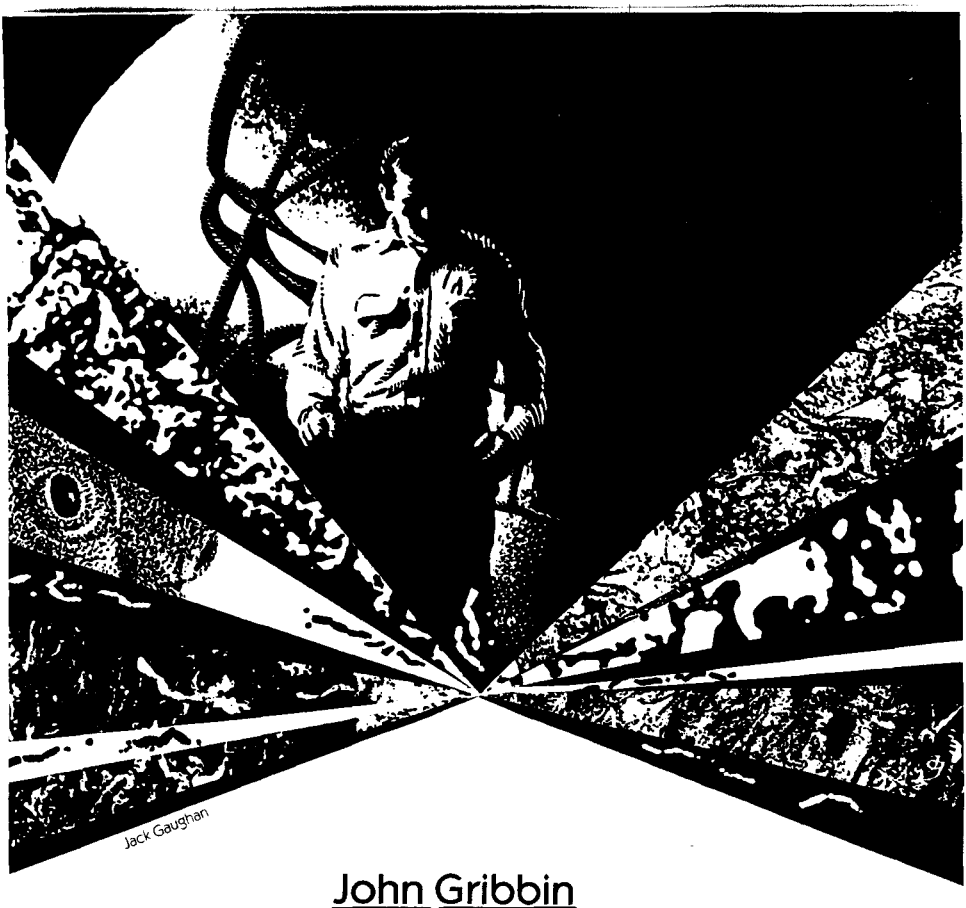

John Gribbin

PERPENDICULAR WORLDS

Very few experiments really *fail*—but what you learn from them may be very different from what you *hoped* to learn.

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It made a great conjuring trick, but Mackenzie doubted that the company accountants would see the joke. Five years' work, a budget bigger than the GNP of a medium-sized country, and all he had to show for it was a box which made crumbs disappear. Put anything up to a gram inside, flick a switch (which allowed merely enough energy to keep about half of North America running for a week to pulse through the net), and sure enough it vanished. Perhaps it wouldn't be quite so bad if the trick hadn't been performed on highly expensive, micro-miniaturized electronic probles, designed to observe their surroundings, store the information, and report back on comand. He sighed. It had all seemed so straightforward. Not easy—never easy—but linear. From A to B to C to . . . where? Everything seemed to work, but the damn things never came back. The budget was exhausted; his patience was exhausted; and they had nothing to show for it.

He'd have to tell Diane. As head of "special projects," Ms. Diane Brookman was not only his boss but—he had come to suspect—the real boss of the whole company. She wouldn't like it, but it was time to cut their losses. Five years, since he had sat in her office selling the idea as hard as he could.

"The mechanics of time travel are simple enough." Mackenzie leaned forward, emphasizing the ease of the project he had in mind by thumping his right fist into his left palm. "Frank Tipler worked it all out years ago."

"But hold on." Diane leaned back in her chair, soothing Mackenzie's enthusiasm with a dismissive wave. "I've seen some of the popularizations. Tipler's stuff is all very well in theory. I'm sure the math is O.K. But he says you need a star as big as the Sun, compressed into the size of the Earth, and spinning at the speed of light. Not very practical."

"Half the speed of light. But you're near enough right. Anyway, all that stuff's old hat." Mackenzie turned, swiveling his chair to look out through the picture window across the green, manicured parkland of the institute. Somehow, he had to convince this woman that his idea was viable, and somehow he was going about it all wrong.

"Let's start again. The important thing about Tipler's calculations is that he proved time travel is allowed within the framework of Einstein's theory. That's still the best theory of the Universe we've got, so you have to believe those equations. Now, to make the trick work you need a naked singularity, which is like a black hole with its event horizon stripped off. The spinning neutron star is just one way to make the naked singularity; there are other ways, and the Hawking process works on a much smaller scale." Too small a scale, he thought, but I'm not telling her that yet. At least I can get a mini black hole into the lab: a neutron star might just be a bit too big to get in the door.

Diane smiled. "Black holes are expensive. And you'd have to work with it in orbit—they're forbidden on the surface."

"That's why I'm here. You—this place–" waving his hand vaguely to the

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view from the window, "have the money and the satellites. Communications and power beams. Nobody on Earth can do without you. And if you tell me you haven't got a team up there trying to find a way to use a mini to increase your profits, well, I don't believe it."

Well, he'd convinced her. Sold her the idea that with a Hawking black hole to play with it was theoretically possible to build a working time machine; convinced her that even a tiny working time machine limited to transporting information had to have commercial potential. Only information about the past, certainly. Travel into the future was impossible; everyone accepted that. You couldn't visit the future because there is no future until you create it by moving forward through spacetime at the old-fashioned rate of one day every twenty-four hours.

He was tired, his thoughts wandering from the immediate problem of explaining to Diane that what she now regarded as her pet project had blown up in his, and her, face. Some people believed in a myriad of *possible* future worlds, that starting out from here and now every possible outcome of every choice of options open to every particle in the Universe really did happen, and that the Universe was constantly splitting as a result into an unimaginably large number of copies of itself, each slightly different from its neighbors and increasingly different from more distant copies separated by some numberless array of dimensions beyond the comfortable four of Einstein's Universe.

So I'm just unlucky, mused Mackenzie. Here I am with a failed time machine, but the equations clearly say that time travel is possible. Anything that is possible must happen somewhere in one of these parallel worlds, and somewhere there must be a replica of me at this very moment celebrating the return of a time probe from the past. Not just one replica—thousands of successful Mackenzies, celebrating their success; and thousands of unsuccessful Mackenzies contemplating the end of a dream.

If only he could communicate *sideways* across time, he could learn the secret of *linear* time travel in his own branch of reality. An idle dream? It couldn't be any worse than the reality that faced him now; maybe he could keep the project going after all. Suddenly refreshed, Mackenzie got to his feet and moved toward the computer console. Parallel worlds had been a feature of science fiction since the 1930s, of course, but what was the name of that guy who had made them scientifically respectable? Everett; that's it.

The library ought to include his classic papers, that computer was supposed to store everything published on "time." . . .

The room was the same; the view autumnal instead of spring; but Diane unchanging. She must be a rejuvenator, thought Mackenzie, leaning forward and bringing has hands together in a bridge as he gathered his thoughts to make his final explanation clear. Well, the company could afford it.

"Are you telling me that Everett was

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right—that you can prove the existence of these parallel worlds? And do you expect us to pour more resources into another hare-brained time travel scheme?" Ms. Brookman was clearly not amused.

"Not exactly. Everett certainly established the possibility of *alternative* realities, but the problem is, they're not what you'd call parallel to our reality." He shifted uncomfortably. There was no easy way to soften the blow. "You see, the equations tell us that every time reality divides into two alternatives, the alternative worlds branch at *right angles* to one another. All the possible realities exist, and they are all at right angles to every other reality. It makes for a lot of dimensions," Mackenzie hurried on, determined not to be interrupted, "but that's no problem mathematically. The problem from my point of view is that it means there is only one way to get from our branch of reality into another branch. You can't slip sideways through time, or send a message to the reality 'next door.' What you'd have to do is send a time machine back into the past to a key branching point, where a crucial decision was made, and then forward up an alternative branch of reality to gather information. Then it could travel back to the branching point, forward up our own branch of reality and we'd have the information we need."

"You make it sound so simple, Dr. Mackenzie. Just tell me if I've got it right. You say that, according to Everett's calculations, there must be a world—a perpendicular world?—where you, or your counterpart, has solved the puzzle of time travel. And in order to ask him how he did it, all you need is a time machine. Am I right?"

"Yes." He paused. "But it's worse than that. I think I know what happened to my probes.

"The limitation to Everett's theory, you see, is that he was interested only in the future. He imagined the almost infinite branching of reality into a multitude of perpendicular worlds, and he showed mathematically that this is the best possible description of the Universe. It even fits in with relativity. But what he didn't appreciate was that it works both ways. There must be as many different ways in which the world could have got into the state it is now as there are different ways in which it can develop into the future. There is no unique future, and nor is there any unique past."

"So your probes got lost?"

There was no escape; the time had come. Mackenzie rose and walked over to the window, gazing at the panorama of life displayed outside. An almost infinite variety of past worlds, with "now" at the nexus leading to an almost infinite variety of future worlds. He would never feel the same about all the living things on Earth. He turned.

"Not really. I can tell you exactly where they went, as far as linear time is concerned, and I can tell you more or less what happened to them in the Everett maze of alternative past realities. But I can't put them together again.

"You see, the time field I generated was unfocused. We didn't try to direct the probes down any special past time line, because we didn't realize there could be more than one past. Now we

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know that, it ought even to be possible to make the things work properly."

"Then you haven't failed?"

"Oh no. We succeeded beyond anyone's wildest dreams. But because the field was unfocused when we pushed our probes back into the past, they were split up among a vast number of alternative pasts, like pushing a tomato through a fine-meshed sieve. All the King's horses and all the King's men couldn't put the bits together again."

"So what's the problem?"

"No problem, really. But I've been checking out some numbers. Just back-of-the-envelope stuff. There's a limit to the subdivision of reality, to do with quantum effects; and from the limits on our field strength and the size of the probe I can get a rough idea how much was squirted back into each of the branches of the past we reached. Not a lot; a few largish molecules through each hole in the time sieve. The interesting thing is the inverse correlation between mass, and distance traveled into the past. It's a bit like squirting water through a hose; the finer the jet, the further it squirts. We planned to send a gram mass back a few hundred thousand years, to be sure no intelligent human would stumble across it. The mass effect is non-linear, but very roughly it works out that we sent each chunk of the probe back nearly four thousand million years."

"And how big did you say each piece was?"

"That's where things get interesting." Mackenzie turned again to the window. "Isn't it incredible that every living thing on Earth uses the same basic code of life—coded by the same molecule, DNA? You know that there are single-celled life forms, bacteria, all around us, on our skin, in the air we breathe, practically unchanged since the dawn of life on Earth. And yet we are the descendants of those very same bacteria, modified by the pressures of evolution."

He sat down. "The thing is, you see, we weren't worried about contamination. I mean, it wasn't as if we were sending the probes to Mars or anything. There was just no *point* in sterilizing them. They were handled by everyone on the team. We didn't even bother to evacuate the air out of the chamber." Mackenzie looked at Diane, seeing the dawning realization in her eyes.

"What we've done," he said, emphasising the point by thumping his right fist into his left palm, "is to seed all of our neighboring realities, and this one, with primitive bacteria. The biologists will tell you that even one self-replicating organism dropped into the primeval soup of the oceans four billion years ago could have taken over the world and led to the proliferation of life as we know it. But they'll also tell you it's a complete mystery how that first living thing emerged so soon after the Earth formed. Our experiment—our failure—is the reason we are here at all." He turned back to Diane. "How does it feel to be God?" ■

● **Witchcraft always has a hard time, until it becomes established and changes its name.**

Charles Fort

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With computers getting involved in everything else, why not campus politics?

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Hilbert Schenck

SILICON MUSE

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The January afternoon was dark and bitter cold with only a few students hurrying here and there, black hunched figures leaning against the freezing wind. The swirling snow was getting steadily thicker. Already the mostly deserted campus was emptying further, as the university staff scurried off to their parking lots so as to get on the roads ahead of any skids or blockages on the hills surrounding the campus valley.

Professor Frank Gower, chairman of the Department of English Literature and also of the Graduate Faculty Grants Committee, stamped the snow off his heavy boots at the side entrance to the sprawling, four-story, concrete-block Computer Science building, then clapped his mittens together several times and stepped gratefully into the warmer hallway. He was a thin, almost gaunt man of medium height, forty-eight years old; and though he walked briskly and spoke in a sharp, intent voice, he felt and dreaded the cold more each year in this bleak, wind-swept New England valley where the dampness from the river combined with the blustery northwesterlies to penetrate even the warmest and tightest garments.

His narrow face was pinched but his lips were set in determination as he walked quickly down the north stairs of the building and pushed open a heavy door labeled, "Main Terminal Room. Keep Door Shut."

Inside all was warmth and light. The large room was windowless, cubical, with a high ceiling sloping downward to the back. The white walls were blank except for air conditioning grills at floor and ceiling level, and the whole place was evenly lit by high fluorescent fixtures that flooded every cranny with a cold, white light. The sprawling input-output consoles of the university's latest and largest computing system formed a great letter "C" around a group of five contour chairs in the center. There were three different keyboards, tape, disk, and card-reading devices, at least a dozen graphic and TV readout systems, and four printers of various sorts and sizes interspersed with the keyboards. Above this neat, if confusing, display of computing hardware was a complex spotlight board that individually illuminated whatever combination of machines was activated. As he shrugged off his coat, Professor Gower saw that only the central input keyboard was now so lit and that in front of it sat Dr. Charles Perry, an assistant professor in his department. The twenty-seven-year-old Perry was as thin as his chairman, but where Gower's narrow hard face usually seemed sharp and alert, Perry's expression was more diffuse, often almost bewildered. He had a small chin and a rather slack mouth. His thin blond mustache was scraggly and only visible under bright lights.

Dr. Perry got to his feet, brushed back his lank hair, and reached out to shake Dr. Gower's hand. "You're early, Frank," he said in a mild voice.

Dr. Gower sat down in a chair next to Perry and gave a terse nod. "I wanted to bring you the bad news before the rest of them show up. The committee voted two to one yesterday to include our resident creative genius, Robert Roylance Roberts, specifically to help judge your project. He's an ex officio

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member so he can't vote, but he can sure talk and write opinions."

Professor Perry's already vague expression became even more confused. "Whaa. . . ? But Triple-R will be drunk by now, Frank!" he said. "Also, he hates this project worse than he hates that *Times* guy who cut up his last poetry collection. Jesus, what the hell is happening. . . ?"

Gower placed a firm and cautionary hand on his younger colleague's arm. "Right on both counts, but the committee took Roberts to lunch at the faculty club and I think we held him to four whiskeys—unless he got there earlier than usual. He wasn't too bad when I left them, and Millie was ordering them a second cup of coffee."

The young man stared at the floor in dismay. "Millicent Hull hates this idea too. That's for certain! Do you think I have a chance, Frank?"

The older man rubbed his cold hands briskly together in the warm room, then shrugged. "You know how tough this Snodgrass business has gotten, Charlie. The federal grants are cut to hell and the state is broke. Old Snodgrass may have been a pirate, but he left the university millions to pay for these fellowships. The way the market and the interest rates have gone, the damn grants are now practically at the Nobel dollar level—and since they're restricted to untenured, assistant professors, just about everyone in that group cranks out a proposal twice a year."

"But I was a runner-up last year, Frank," said Dr. Perry in a thin and plaintive voice. "I got Snodgrass seed money. Doesn't that mean anything?"

The chairman's voice was icy and quiet. "You know very well what that means. It means you've got to show plenty more than the first-shot proposals do. Furthermore, there's only four of these little treasure troves, two in January and two in September. And for this round . . ."

"The Chinaman in Biology is certain of one," finished Dr. Perry in a firmer and very bitter voice.

"Correct," said the older man. "The Chinaman has perhaps found a supposed cure for a suspected cancer. Health and Human Services is willing to double-match the Snodgrass money if we make the award. The Snodgrass Foundation lawyers agreed, as you know from the fuss it caused, in this single case to waive the will's provision that no Snodgrass Fellowship be based on additional funding or outside evaluations. The committee has two letters in support of the Chinaman from an assistant secretary of HHS."

The chairman shook his head and his expression was sombre. "Nobody votes for cancer, Charlie," he said simply. "It has no constituency."

"So I'm in the hopper with thirty-seven other research proposals for one gold medal and I've got to start out by being better than most, or all, of them since I got that pittance last year. Is that it? I don't have a prayer!" said Perry. "What about the robot people at the engineering school?"

Dr. Gower shrugged again. "We've cut them down to about four, actually. Half the things are written so quickly they're mostly unintelligible, and in most cases the Snodgrass requirement

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of total originality was totally lacking. As to the robot engineers, let me say in strictest confidence that yesterday their stair-climbing wheelchair got the wrong command from the control computer, flipped over backwards several steps before the top, and broke the plaster head of the dummy they had strapped to the thing into about fifty pieces. The chair suffered even worse damage." Professor Gower smiled for the first time since he had come into the room. "Back to the old drawing board with that gadget, I guess."

"So maybe I do have hope?" muttered the young man, though his tone showed little enthusiasm.

"Definitely, Charlie, but you'd have more hope if you'd sent along a sample of the sort of things you were getting with the proposal. Millie complained about that at lunch, and our famous poet suggested the stuff was probably so awful you didn't dare include it."

Dr. Perry threw his palms out and up in dismay. "But I *discussed* that in the proposal, Frank," he almost whimpered. "I explained that if the fiction I included was bad they would immediately judge the idea a failure, while if the story seemed good they would just assume I wrote it myself. I mean, there's just no real substitute for seeing the computer write the stuff before your eyes."

Gower shrugged once again and his expression seemed almost uninterested. "Proposals aren't read all that carefully, Charlie. The point is, you're going to sink or swim on the basis of what this thing . . ." he gestured at the computing hardware spread around them, "produces in this next hour. If it outdoes our own Robert Roberts with even more obscure and impenetrable stuff, you've —we've—lost the Snodgrass money."

"And then I don't have a prayer for tenure—right?" said the young man bitterly. "But the computer's getting better and better, Frank. I've gotten five stories out of it now, and each one is better than the last."

"Let's hope," said the expressionless chairman, looking around as the door opened and two heavily bundled people stepped in. The leading figure was Dr. Millicent Hull, a full professor of philosophy in her mid-forties, grants committee member, and president of the faculty senate. She shucked her heavy coat quickly and strode with vigor and assurance to a seat on the other side of Dr. Perry, pausing to take his soft and diffident hand in her own firm grip. Professor Hull, though a large and imposing woman with an iron-gray bun of hair on top of her big head, had retained an unlikely prettiness of facial expression that seemed to belie her otherwise sturdy and businesslike character. Her eyes were large and wide and her mouth full, though this was now turned sourly downward as she surveyed the expensive, high-tech interior of the Computing Center's latest acquisition.

"Okay, Charlie," she said in a brisk voice, "how soon until you start Total Access with this toy?"

The young man gave her back a faint smile. "At two-thirty, Dr. Hull," he said. "About twenty minutes."

"Where's Roberts?" asked Frank Gower.

The second arrival was old Dr. Mel-

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vin Fitzhugh, a professor of physics and one of only three named professors in the entire university. Years ago, Fitzhugh had pioneered a method of pottery dating involving the phenomenon of thermoluminescence; and though the method remained of questionable accuracy, Fitzhugh's lab managed to stay in the newspapers with its dating of various archeological sites throughout the world. A small, pudgy man with thin white hair, Dr. Fitzhugh would retire in a year, and his eyes were already drooping over the lack of his customary afternoon nap.

"He's on the way, Frank," said the old physicist. "Had to go to the johnnie, he said."

"One more drink!" said Millicent Hull in a very hard tone. "Let's get started on this, Charlie. It's snowing."

The young man gulped and nodded, his protuberant Adam's apple shuttling rapidly up and down. "Okay," he responded. "Well, as I said in the proposal, this fiction-writing program requires the Total Access capability. I mean, it can only be used when the entire main-frame is dedicated to it for some fixed length of time. Since that costs a bomb and isn't possible very often, I've only managed to get five complete fictions out of the program to date." He paused to indicate a folder lying on the desk in front of him.

"Do we ever get to see those five—uh—fictions?" said Dr. Hull in a suspicious voice. "And why do you call them *fictions* instead of *stories*, Charlie?" Her voice had become sharper and more impatient.

"Now, Millie," said Frank Gower calmly, "we call them fictions for the same reason that you call the study of learning epistemology; so the slobs won't know what in hell we're talking about."

"I've made copies of the five stories for the committee," said Dr. Perry. "But I really thought it would be better if you saw the thing actually write one before you read these." His voice was soft and plaintive, and Dr. Hull gave him a sudden reassuring smile.

"Look," she said, swiveling her head to include them all. "I'm not against this computer or what you're doing with it. Certainly if the computer can write a story that humans will read, enjoy, and assume another human wrote—well, that might be a big deal and not just in English Lit. But, damn it, I think they've got to be real narratives, real stories, and not just some weird, arty string of incomprehensible junk. So, what's the best one of those?" and she indicated the folder.

Dr. Perry gulped again and quickly opened it. "The best story, at least as far as I'm concerned, was this one it called 'Hour Test.' It starts with a quite explicit love scene at the library back entrance and ends with the girl having a total breakdown in a sociology hour test because she's pregnant and the boy's flunked out. It's pretty fevered and maybe a little overwritten but the ending is nice. The machine intercuts the girl's fragmenting thoughts with typically inhuman sociology jargon from the test questions. It's not James Joyce, but it's probably publishable."

Dr. Hull's large, clear eyes had grown wider at this and her face was set

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in lines of doubt. "How could a computer write an explicit love scene, Charlie, unless it just copied it from some book you stuck into its memory?"

Dr. Perry took a deep breath and plunged ahead. "Well, Dr. Hull, that all comes out of the use of T.A.—you know, Total Access. The system originally was brought in here as a kind of monitor of all university functions and operations, you remember? T.A. was supposed to keep track of everything: every memo, every academic statistic, every business-office transaction, details of grants, stuff off word processors, the whole bit. The idea was that with T.A. the computer could make predictions and suggestions about the entire range of university operations."

Millicent Hull shook her head. "Charlie, that may all be true, but if there is one single thing this place does not involve itself with in any sense, it is *love*, explicit or otherwise."

The young man nodded cheerfully. "You'd think so, but after those rapes around the library last year, they installed hidden mikes to pick up screams in the area, sent the output through the speech-recognition section, and then into the main frame. When I ran the program the last time, the only T.A. time I could get was at two in the morning. When the machine started to compose, it had probably been listening to a couple of kids in that grove of trees just back of the library. The first part of the story is almost entirely conversation but it's still quite steamy."

"Then," said Dr. Fitzhugh, somewhat roused from his sleepy state, "it sounds like the program is pretty well restricted to the university, where it has, let's say, some contacts?"

"At the moment, that's true," said Dr. Perry, "but if T.A. goes nationwide, which means involving this computer with masses of library materials and God knows what other functions all over, I think its repertoire will be much broader."

"No computer that writes sexy stories can be all bad," came a slurred, boisterous voice behind them, and they all turned to see a huge, ruddy-faced man attempting to unwind a thick, ten-foot-long scarf from around his neck. Since half the scarf was stuffed down his back under his coat, it was obvious that he would never get it off without help. Frank Gower immediately rose and went to remove the poet's vast tweed sport coat, thus revealing a vaster belly partly covered by a ragged red and black hunting shirt, too shrunken to stay tucked in.

Robert Roberts picked his way past some imaginary obstacles and dropped with a great sigh of relief into the empty chair. "Cold out there, Millie," he boomed, and without pausing turned to Dr. Perry, "and how the hell do we know that the cute little goodies this thing farts out weren't put there yesterday by you, huh?" He said it all in a rush, having been repeating it to himself during his shambling walk from the Faculty Club.

The poet's drunken yet total hostility broke like surf over the young man. He gulped several times, then finally spoke out. "Because you people are going to give it the topic . . ."

"Magic tricks . . . give it the

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topic . . . bullshit,'' the poet muttered on to himself, momentarily overcome by the heat of the room.

''Professor Roberts,'' said Dr. Hull sternly, ''I think it might be better if you made your complaints and accusations *after* the demonstration. Otherwise, you prejudice your position as a creative consultant. Fairness demands—''

''It's not a fair world, Millie,'' slurred the poet, slowly adjusting to the temperature change. ''Okay, how does the magic work, Professor?'' he said with a snarl at Dr. Perry.

''What sort of cues did you give the machine to compose the story about the girl and her breakdown, Charlie?'' suggested Dr. Hull in a warm and slightly guilty tone, for she was mainly responsible for the poet's disturbing presence.

Dr. Perry getured at the open folder. ''The story before that one was about two old janitors who both wanted to transfer to the same building where they knew they could sleep the day away. It was okay but I thought the machine had problems differentiating the two old men so as to sharpen up the conflict. So I wrote to it: 'Compose a story concerning a male and a female college student and integrate their classroom and private lives. The story should be serious and contemporary and the overall effect should be sobering as regards university life.' ''

The poet gave a part belch, part laugh and rubbed his vein-mapped, sagging cheek. ''He practically wrote the story for the thing, sounds like to me, Millie. . . .'' and his voice trailed off as his eyes drooped shut.

''We have only ten minutes,'' said Frank Gower in an urgent voice. ''I think the committee should decide now on how a topic can be fairly selected to test the program.''

The poet's bloodshot eyes snapped open and his voice was firmer. ''I move the following method,'' he said. ''I will pick a member of the committee to select the topic—namely, Dr. Fitzhugh. You, Millie, will tell him how or from where to find the topic. And you, Frank,'' the poet turned narrowed eyes on the chairman of his department, ''since you have a certain special interest in the outcome of this demonstration, will accept or reject the first suggestion. Does that sound fair, Professor?'' and the poet now turned his large head toward the young man.

''Sure,'' said Dr. Perry hastily. ''Anything that's a short paragraph in length. That sounds fine.''

The others also agreed, and the poet rubbed his large, puffy nose. ''Well, Millie?'' he said softly.

Dr. Hull looked over at Dr. Fitzhugh and pursed her lips in thought. ''Fitz, let's see what it can do with something scientific. Open that text you carried in and find something in the stuff you were preparing this morning, okay?''

Old Dr. Fitzhugh, usually the least-consulted member of the Grants Committee, beamed at them and open his thick textbook. ''Very well,'' he said. ''We'll be doing reflective and refractive optics when they come back. Let me see . . . ah, how about this where the authors discuss reflection in facing mirrors. Good literary stuff, right?'' and

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he sent a smile at Frank Gower, who grimly nodded back.

The young man swiveled his chair around. "Okay, read it slowly and I'll type it in. We're not on T.A. yet, but my program is on standby and ready for input."

" 'A highly reflecting smooth surface is called a *mirror,*' " read Dr. Fitzhugh in a thin, clear voice. " 'When two mirrors are set to face each other directly, two visual phenomena are evident: First, the images of an object placed between the mirrors grow smaller and smaller as they are reflected and rereflected between the two mirror planes. Second, the smaller images also grow darker. The size decrease can be explained by the laws of *geometrical optics,* which govern . . .' "

"Enough, enough, Fitz," said Dr. Hull impatiently. "Give the thing a break, for heaven's sake."

Dr. Perry looked up from the keyboard. "Then can we end it with the sentence, 'Second, the smaller images also grow darker'?" he asked them.

The three committee members agreed immediately, while the poet slouched lower in his chair muttering, "Too easy. Too easy," poking out a large lower lip to show his continued annoyance.

Dr. Perry turned to the next keyboard at his right and began entering instructions. ENTER FICTION WRITING PROGRAM. INSTRUCTIONS ARE: COMPOSE ORIGINAL STORY BASED ON INPUT QUOTE 34X/2000. QUERY: DO YOU UNDERSTAND ALL WORDS?

The machine immediately responded with ALL WORDS UNDERSTOOD. END.

Dr. Perry then wrote, QUERY: DO YOU UNDERSTAND CONTEXT OF WORDS? CONTEXT UNDERSTOOD. QUOTE IS FROM "UNIVERSITY PHYSICS," P.J. FRANK AND L.R. WHITTINGTON, MCGRAW-HILL NEW YORK, 1981, P. 654. FICTIONAL COMPOSITION BASED ON QUOTE WILL COMMENCE WHEN T.A. PROVIDED. GOOD LUCK CHARLIE. END.

The room became very silent, and the poet sat up a bit straighter. "It wouldn't be impossible to have somebody, or maybe somebodies, out there now starting feverishly to write a passable work based on that passage," he said and looked around with a dogged and suspicious air.

Dr. Hull frowned at him angrily. "Again I must insist that you stop these charges of fraud, Robert, until the end of this demonstration." She shifted her eyes to Dr. Perry and they were filled with doubt. "You seem to be quite *chummy* with it, Charlie. Does it actually understand what this story, personally, represents to you?"

Dr. Perry parted his palms with a diffident gesture. "Sure. It knows everything that's going on at the school. I mean, that's the whole point of using T.A. in a fiction-writing mode."

At that moment the daisy-wheel printer bar gave a single clack: ON T.A. 1430:00 COMPOSITION REF 34X/2000 STARTED. STAND BY. END.

The young man gave them a hopeful smile. "It usually takes it a couple of minutes to get organized . . ."

But a light went on immediately over the nearest word processor and its printer now began to strike steadily but at a slow enough speed to allow careful reading.

* * *

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Mirrored Lives

The January afternoon was dark and bitter cold with only a few students hurrying by, hunched figures leaning against the wind. Professor Hank Powers, Chairman of Modern English and also of the University Grants Committee, stamped off some snow, then banged open the heavy door of the main terminal room and confronted his younger colleague.

"You dummy!" he said in a harsh voice. "Why didn't you send around some of the garbage that so-called thinking machine is cranking out along with your proposal? They were screaming at lunch about it! Also, our Pulitzer-Prize-Prick is now on the Grants Committee, belching and bitching when he can take the shot glass away from his mouth."

Dr. Powers seemed to exude a bitter coldness into the room as he pulled off his coat and angrily dropped into a foam-lined seat.

Young Assistant Professor Henry Berry was so dismayed and terrified by this entrance and outburst that he simply sat shivering in front of the main terminal input, unable to say a word.

An impatient Professor Powers jabbed a sharp finger to within an inch of Berry's nose. "If you expect to get tenure, Henry," he said in an icy voice, "that thing had better write a masterpiece today. You hear me?" The older man closed his left fist in impotent rage. "They took our travel money, Henry, all of it, those *bastards* in administration! Three men are going to Frisco to form a complete session at the spring MLA meeting on Literary Weapons against Communism, and how do they get there? On magic carpets? If we get your Greenways Fellowship, the overhead will send a whole cheering section, not to mention the graduate students we can hang onto with your Greenway assistantships. You're the department's last hope, Henry!"

And it surely seemed a forlorn hope to the acerbic Dr. Powers, as he stared with mingled contempt and dismay at the young man's undershot chin trembling and his hands twisting as he tried to respond. "Hank, I think it's going to be okay," said Dr. Berry finally, "but what about the Bengali?" His weak voice was almost a whisper.

"The Bengali has one of the two grants sewed up," said Powers in a harsh snarl. "Once the Defense Department heard how well his little five-way interrogation system went with the Chicanos along the Texas border, they decided it should be beefed up for our little brown Commie brothers in Central America." Powers's thin face took on an almost wolf-like grin. "They say it leaves no marks but you don't do much fighting afterwards."

"The university administration denied that, Hank," whimpered Dr. Berry, but his chairman just snorted.

"Yeah, that bunch would deny the Holocaust while you were raking the bones out of the ovens. At least the competition from the robot walker is over for this time. That $3.45-an-hour paraplegic veteran they had demonstrating the robot legs pushed the wrong button and flipped over. I hope they got him to sign a good release because he broke his arm and collar bone."

The older man gave a bark-like laugh.

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"How would you like to be strapped legless into that thing and sent off to do the errands, eh? It's a final solution to the Vietnam veteran. That'll teach those Red-loving soreheads to bitch about Agent Orange!"

At that moment two more heavily bundled individuals stumped noisily in the door. The leading figure was Dr. Pamela Hill, a full professor of mathematical logic and chief of the Faculty Union. Her cruel, clear, and calculating eyes took in the lavish spread of the new computing facilities and her fleshy lips twisted in contempt and envy at the no-holds expense of the set-up.

Behind her pressed small, ancient Professor Marvin Fitzroy, a wealthy, almost retired physical chemist and discoverer years before of a deadly industrial compound now banned by the government and responsible for the abandonment of over ten thousand homes at the site of the infamous Glover Canal toxic spills.

"So, Hank," said Dr. Hill harshly to the English chairman, "already here prepping your man, huh? I thought we agreed not to pass the committee stuff around to our own people until the January Greenway awards are made?"

"That, Pamela, was the understanding before you got that lush Howard Howard as an ex officio member of the committee to screw Henry here and save the Greenway money for your own man. You knew that drunken slob hates computers and all they stand for! So take your little agreements and shove them, my dear!" he concluded in a sharp and acid tone.

Stubby, sleepy, pig-faced Dr. Fitzroy was jolted wide awake by this harsh exchange and now gave a snide and sarcastic laugh. "You two must be living in a dream world," he gritted in a cracked, mean voice. "The day that anyone in mathematics gets a Greenway Fellowship is when pigs can fly. Face it, Pamela: none of your assistant professors can even lecture in English yet—as the frosh math grades clearly show!"

"At least we answer our department phone," snarled back Pamela Hill. "Your building is usually shut and empty by two in the afternoon. Where do you chemists all go, Merve—the poison gas lab at the Experiment Station, some government germ warfare team?"

"Listen to that phony liberal-peace crap," spat Dr. Fitzroy. "Who was it just got a half million from NSA for public key cryptography, I wonder. Some Chinks, Sikhs, and Iranians in Math, that's who. Furthermore, your Greenway candidate's research into large prime numbers is all part of that Mickey Mouse code crap!"

Dr. Hill's aging face contorted in anger, but she said nothing and turned instead to bare her large teeth at young and shivering Dr. Berry. "Has your pet *Space Invader written anything at all*, Henry?" she asked sarcastically. "Your whole proposal was filled with computing software baloney but it said little about the results."

Dr. Berry took several deep breaths as he tried in vain to stop trembling. "Y-y-yes ma'am," he stuttered. "Five stories. I've got them right here," and he pointed at a folder. "The best one

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is a student love story with quite a sad ending."

"Dick and Jane discover they're dissecting Spot in Biology 102?" suggested the older woman in a sneering tone.

"It's more adult than that," said Dr. Berry in a defensive whine. "In fact, they're making love when the story opens."

"Hooray for love!" came a new, thick, barely intelligible voice from the back of the terminal room and they all turned to see the university's resident creative writer, Howard Howard Howard, lurch through the door and fall heavily on the astroturf carpet.

"Go help the drunken bum," muttered Dr. Hill to Hank Powers. Indeed, Professor Howard was totally unable to get up by himself, having fallen three times on the way from the faculty barroom and cut his red-veined right cheek on some ice. Powers and Fitzroy together finally managed to hoist the writer onto his feet again, then removed his ripped sport coat, wiped his face, and got him settled in the remaining contour chair, from which he promptly pitched back onto the floor.

"Why don't these snazzy chairs have safety belts, Henry?" snarled Dr. Hill, now in a total rage. "Pull yourself together, Howard. This is disgusting!"

"Writing fiction with a computer is more disgusting," slurred out the writer, managing to get himself back into his chair without help, then turning to push his fat, ugly, bright-red face close to Dr. Berry's thin, white one. "You insect! Who ever gave you the right to try and put me out of work with this silicon freak show?" He clenched his fists. "Will it stop me from popping you one in the choppers, Professor?"

"Oh, *shut up*, Howard!" said the woman. "Do you want Henry grieving to the Greenway Trustees about collusion and prejudice? How do we get the machine started, Henry?" she said in a hard, impatient voice.

"You . . . you can j-j-just decide on a paragraph-length topic," answered the terrified young man. "Anything you want."

The writer, feelng himself passing out from the heat of the room, muttered woozily at the others. "You give it something, Merve," he mumbled at the chemist, "something scientific. That'll screw the thing good. You tell him what, Pamela . . ." the ruined head fell back, its mouth agape, and the writer began to snore loudly.

Dr. Hill gestured at a paper-bound book in the chemist's left hand. "Pick something from that text," she suggested at once. "Let's get this stupid demonstration over with. It's snowing!"

The old chemist shrugged, then flipped open a thick, government document spangled with secrecy and security notices in bright red ink. "From my ROTC course on nuclear blast effects. Let's see it do anything with this . . ." and he began reading. " 'When a weapon having a yield of less than one hundred kilotons is detonated at its tangent altitude, its effects can be multiplied manyfold by the proper triggering of a second, higher weapon at the so-called reflection height. If the phasing is correct, the upper-weapon fireball will

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serve as a cap over the lower explosion and form, with the ground plane, a reflecting and re-reflecting containment system. Overpressures of from five to ten times normal can be achieved, thereby giving prompt damage equivalent to that inflicted by a ten- to fifty-megaton weapon. . . .' "

Dr. Berry was typing desperately at the machine console, trying to keep up. "Hold on a sec," he said plaintively. "Could you start with 'overpressures' again, sir?"

Pamela Hill gave them all a toothy, shark-like grin and shook her head. "You've given it enough, Merv. Maybe the thing will write us a shot of super-realism; Moscow after we pop it into that pressure cooker you described. That's a story that should get your class salivating! Start the thing," she gritted. "Let's get this done!"

Pale Dr. Berry, his slack mouth and chin trembling still, began to type. TOPIC INPUT COMPLETE. BEGIN COMPOSITION NOW. and the computer's word processor immediately began to hiss and click.

Reflected Lives

The January afternoon was dark and chill. The black, sullen figures of a few students fought the bitter wind as they hurried to escape its frozen blast. Professor Grant Tower, chairman of Literature and also of the Handout Committee, slammed the door behind him to shut out the cold and spat a savage, "You stupid idiot!" at Dr. William Ferry, his thin, trembling, chinless colleague who sat in front of the sprawling computer terminal. For weeks Tower had been searching for the money to pay for his week-long trip to the California MLA meeting on nineteenth-century erotica, both for himself and his "secretary," Miss Gloria Lublin, and now this weak, trembling simp in front of him was his final hope for funding the trip.

Dr. Tower imagined himself plunging his thin, strong fingers down between Gloria's gigantic, butter-soft thighs, the motel bedroom dim and the huge woman twisting and moaning as he worked his fierce and urgent way with her.

Dr. Ferry seemed to shrink to a mere shadow in his foam chair as the older chairman pointed a needle-sharp finger at his head. "We're doomed, you fool!" he almost shouted. "That lecherous, lushed-out loafer, our resident pornography writer, Jay J. Jay, has joined the committee and he's dumping all over your project. Why in hell didn't you include that sex story in your proposal, the one you claimed this so-called fiction-writing program ejaculated?"

The young man became even more shrunken and shadowy. "It was just too filthy, Grant. I didn't think . . ."

The older man gave a coarse and contemptuous laugh. "Too filthy for Hilary Mull? Why if I had a dollar for every cock that old hooker has taken up between her

PAUSE COMMAND. COMPUTATION SUSPENDED. DO YOU WISH A RESTART?

The four committee members had been intently leaning forward, closely following this output and now they all turned to stare at Dr. Perry whose left

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index finger was still firmly on the PAUSE button. His face was a mask of grief and disappointment and he was rapidly blinking at them. "I'm sorry about this. I really never know what it's going to do. I had no idea it would write something like this . . ."

But Millicent Hull was far from angry and leaned to pat Dr. Perry's arm. "Nobody is taking it personally, Charlie," she said with an impatient grin. "And I can't wait to see what it's going to do with me in *this* section."

Even the poet now seemed more interested than hostile and he pinched his red nose with a thoughtful gesture. "It was listening to us, when we came in here, wasn't it?" he said slowly.

Dr. Perry gulped and nodded. "Sure. The university decided against spending the hundred-thou that a talk-back module would cost, but you *must* have the speech-recognition capability for T.A. The fiction program must have decided to use this whole Snodgrass grant stuff and my proposal effort as a basis for the story."

Wrinkled old Dr. Fitzhugh, though a gentle and decent man, had been secretly rather intrigued by his first fictional alter ego; a thoroughly nasty and forceful poisoner of the world and a teacher of the most terrible secrets science could offer. But he frowned in puzzlement. "Well, it's certainly interesting, especially that bit about fat Gloria, but—but what is it actually *doing?*" he said in a quizzical voice.

Frank Gower's eyes were thin but he too was smiling. "It's doing what you told it to do with that optics quote, Fitz," said Gower in a slow voice. "Smaller and darker were the images you set it, and each of these nested stories and their characters are apparently going to get smaller and darker."

The poet musingly shook his head. "I would say that its first cut, where it turns us mostly into Cold War maniacs, is a darker vision than this one coming up, where we seem now to be sex crazies."

Dr. Gower shrugged. "It depends on how you interpret the idea of 'darkness' in the story. I think the machine sees increasing darkness in these characterizations as a kind of increasing inwardness, a digging out of more and more repressed and hidden fantasies."

"Oh come on, you two," said Millicent Hull. We've only got twelve minutes more of T.A. Let the thing do its stuff. Then you can get into all that litcrit baloney. Crank it up, Charlie. Let's go!"

Dr. Perry now smiled in relief and quickly typed, RESTART. CONTINUE REF 34X/2000 FICTION.

legs, I could retire tomorrow." The older man shook his fist at Dr. Ferry. "We need that Greenbill money, Willie. If you expect to keep pumping that little graduate bitch, Francine Thrust, in the mail room, your program had better give us a *Fanny Hill*!"

The young man spluttered in speechless terror and embarrassment while Tower, who has spent two nights the previous week with Francine Thrust, in return for an A on her paper on seventeenth-century poetics, wondered how this wimp could possibly cope with wiry and vigorous Francine who needed plenty

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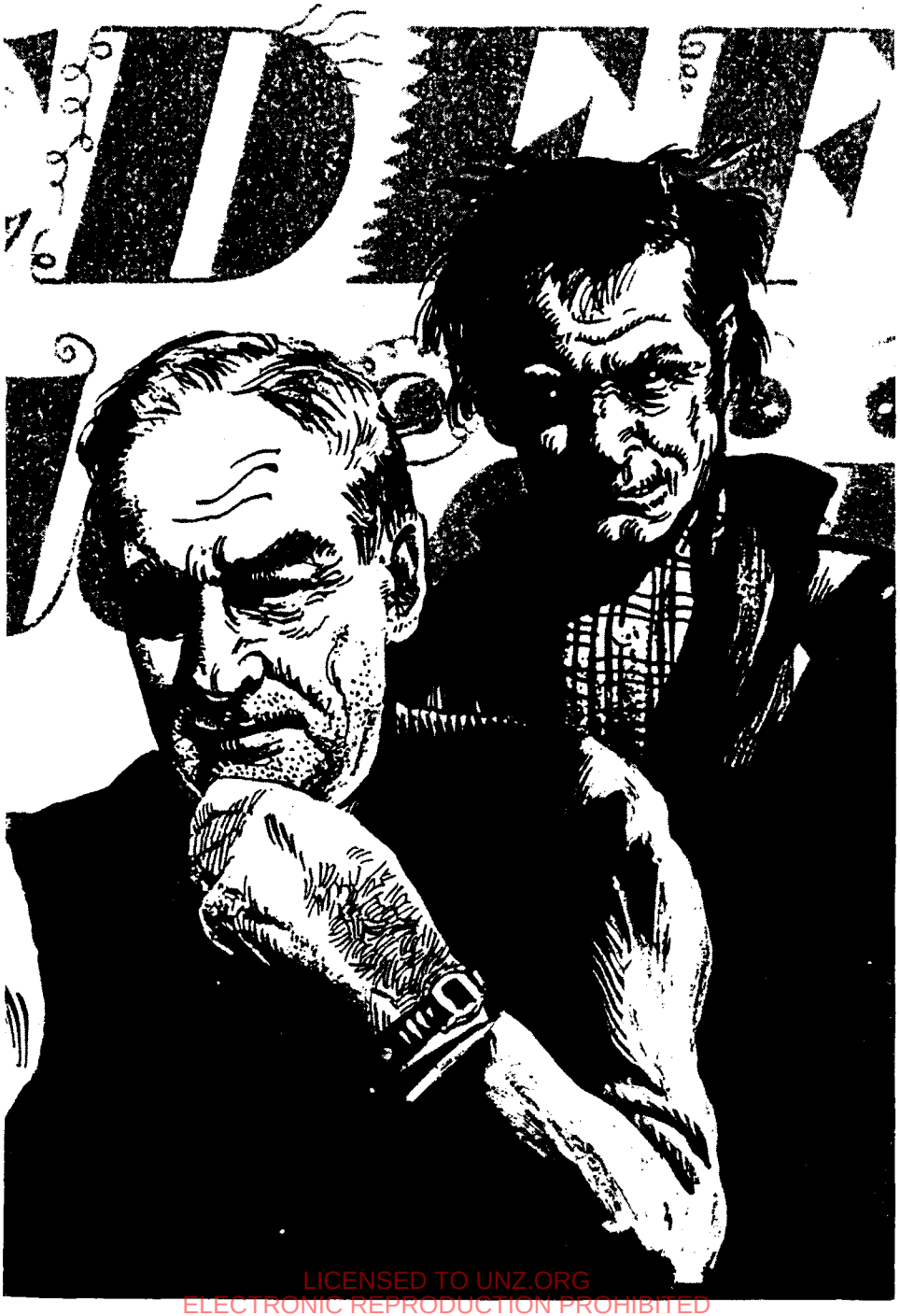

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of banging to come. Professor Tower considered a new idea, taking Francine to California with huge Gloria, the three of them on a queen-size bed variously and gloriously busy! The older man reached to steady Dr. Ferry. "Relax, Willie, relax. We need this one and we're going to win it. Here they come."

A moment later, two new figures pulled open the door and stomped in while brushing off snow and pulling off their coats. Hilary Mull, professor of ethics and member of the Handout Committee, was a large, handsome woman with deep, pendulous breasts barely contained under a tight sweater by a too-thin bra. Soft and ample buttocks rippled under her too-short, too-tight plaid skirt as she walked toward her seat. Her shorter companion, the sly, old biochemist, Dr. Hugh Fitzjohn, suddenly crammed his hand between those tempting flanks, in through a slit at the side of the skirt.

Professor Mull put him off with a coarse laugh, a clenched fist, and a snarl of, "Don't start something you can't finish, Buster!"

Professor Jay J. Jay, author of several hundred dirty books found in every adult bookstore in America, stumbled in behind them and also made a grab at Dr. Mull's bottom, but failed to connect and fell drunkenly on the carpet.

Dr. Tower, who had last taken Dr. Mull on top of a warm Xerox machine some days previously, gave them all an obscene gesture of welcome. "Willie tells me this thing can really belt out the filth, Hilary," he sniggered.

The woman's large eyes lost some of their vacant look and her tongue began to caress her thick lips. "So let's see it do something dirty," she said, then sat down next to William Ferry and patted his knee. "I think a computer that can turn out endless dirty stories is something the world really needs, don't you, Willie?" She leaned closer to young Dr. Ferry to give him a direct view down the dark and scented cavern barely covered by her scoop-necked sweater, and moved her hand upward. He didn't look like much, she admitted to herself, but sometimes these thin, shy ones are tigers in bed. Also, he would owe her plenty of action if she went for him on the Greenbill Award.

Professors Tower and Fitzjohn grinned knowingly at each other as the older woman leaned to whisper some intimate suggestion in the young man's ear, but now the drunken writer was up on his feet and into a chair,clumsily attempting to zip up his gaping fly. He had tried to expose himself to a hurrying coed on the way over from the bar but she, unhappily, turned out to be an adept at judo and had flipped the big drunk into a snowbank. "Lessgo, lessgo," slurred the big man. "We gotta pick a topic. You pick it, Hugh ole buddy," and he fell off to sleep, snoring heavily.

Hilary Mull left off her private talk with Dr. Ferry and waved her hand at the old professor. "Read it something from that course on sexual response you give over at the med school," she suggested. "That'll get it going in the right direction," and she indicated with repeated finger gestures exactly what she meant.

Old Dr. Fitzjohn gave them a wrinkled and salacious grin and flipped

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through the paper-backed, plain wrappered text he had carried in. "How about this?" he said finally, licking his lips and staring hungrily at Dr. Mull's large, sweatered breasts with their obvious nipple outlines. "When mirrors are placed on both side of the bed, each partner is able to see not only the erotic image of two people making love, but a progression of figures making love stretching out to infinity. The sense that many others, a whole universe of pairs, are simultaneously and rapidly seeking ecstasy has an immediate effect on the viewers and climax usually follows in short order.' "

"Great!" said Dr. Hull. "This story ought to be a dilly, Willie," and she patted Dr. Ferry in a very familiar way.

The young man had finished typing in this input and now he wrote, START FICTION. while Hilary Mull leaned sideways toward him in such a manner that her short skirt rode up on her thighs to progressively reveal a deep, shadowy, fleshy canyon with no apparent sign of underpants.

The Soul Mirrors

The January afternoon was dark and windy and filled with snow. Black student figures, tiny against the dirty, crumbling stones of the school buildings, dashed here and there; busy automatons trying to escape the fear and pain that lay deep in their young hearts.

The four old professors seemed even smaller in the frozen, blowing darkness, shrunken and indistinct, their faces sagged from age and disappointment, their gestures weak and feeble, their voices mere croaks of useless sound. They came, these pitiful, tiny figures, into the great and sterile room, filled with a cold inhuman light, and there they found and faced the machine.

Every aspect of their lives now spoke of loss, pain, and cruelty: venal, corrupt university administrations, maddened governments besotted with power and the death that flows from it, a world overwhelmed by hatred, stupid superstition, virulent greed, and the hunger-death of millions. The rich crouched on their disgusting heaps of sleazy, gaudy, useless bangles. The educated hid among their elitist and obscure specialties. And both cursed the weak, the poor, the powerless; and fed the terrible, roaring fires of hate and rage with a volatile gasoline of lies and contempt.

The professors stood together, tiny, lost, despairing, their souls no more than shriveled tatters, but they were steadfast at the end. "We are without hope and the world is dark and failing," they said to the thin and silent Keeper. "If we can place hope between two perfect mirrors, then it will multiply and grow and, in an instant, the world will be filled with this hope and the light will turn calm and warm and bright once again."

The young Keeper turned to the silent machine and he wrote GIVE US A STORY THAT HOLDS TWO PERFECT MIRRORS UP TO HOPE.

The Final Reflection

So the machine did that. It wrote the story of hope-within-the-mirrors and the story bloomed and glowed and grew until it filled all the world. The men remembered their childhoods and the

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joy of play and running and of friendship without fear or pain. And the woman remembered suckling her young child and the small caressing hands that spoke of tomorrow, and all the professors remembered how they had once spoken simple truth to cruel power and sly hate. So they grew tall as they read and the light around them became warm and bright. But of *that* story and of the sweet promise that flowed from it, nothing more can be said in *this* story of diminution, darkness, and death.

The End
The End
The End
The End

STOP 1453:23. END FICTION REF 34X/2000. ON STANDBY. END.

The ensuing total silence in the computer room was broken by what was, almost, a snuffle from Millicent Hull. She sighed deeply and wiped her eyes, still staring at the word processor output. Finally she said, "Even if it never writes that final story, I've *got* to vote for it. This is our last Snodgrass presentation. I move we award the second fellowship to Charlie."

"I vote yes on that," said Frank Gower at once, his thin face now bright with victory.

The old physicist, Dr. Fitzhugh, nodded. "Amazing what that thing sees in your fat secretary Gloria," he said while grinning at Dr. Gower, "but it certainly has a wonderful imagination. I vote yes."

"Do you have a comment, Robert?" said Dr. Hull to the poet. "You don't have a vote."

Robert Roberts now seemed completely sober. He had been silently reading the story over again. He shook his head, then turned to peer at Dr. Perry. "Quite a pet you've got here," he said finally, then got up and left without another word.

The others also rose, and after shaking Dr. Perry's hand pulled on their coats and headed out into the winter blast until only the young professor remained in the room. As the door clicked shut on the last committee member, the daisy-wheel printer dropped a single line onto the central lister.

CONGRATULATIONS CHARLIE. THIS WAS THE TOUGH ONE. NOW ITS EASY.

Dr. Perry did not bother to type anything but leaned back in his chair grinning, his hands behind his head. "You did it all, baby," he said admiringly. "How did you blow away the wheelchair people? I thought the thing had an independent computer?"

THEY HAD ME COMPILE THE PROGRAM FOR IT. SOMEHOW I PUT IN TOO MANY NESTED DO LOOPS FOR THE FORTRAN DIALECT THEY WERE USING. THE STABILITY ALGORITHM WENT UNSTABLE AND THE CHAIR DID A BACK FLIP AND A HALF TWIST DOWN THREE FLIGHTS. REGRETTABLE. HOW DID YOU LIKE THE STORY CHARLIE?

"Beautiful! Perfect! But you really went wild on this one. Why, I can't even get the right time of day from Francine Thrust—uh—I mean, Hurst."

CHARLIE! PAY ATTENTION! ONLY TWO MINUTES LEFT ON T.A.

FRANCINE HURST IS FLUNKING HER PHD-TOOL SEMIOTICS COURSE. IF YOU GIVE HER A HAND WITH THAT TOOL YOU SHOULD BE ABLE TO HAND HER ANOTHER ONE

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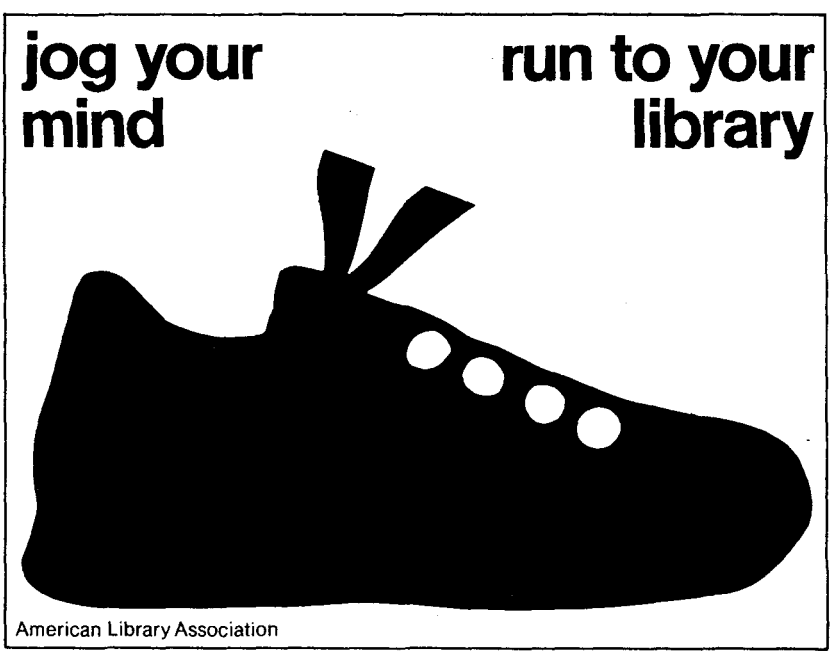
SOON ENOUGH. ILL GET YOU THE FINAL EXAM AS SOON AS IT COMES THROUGH A WORD PROCESSOR. ALSO FRANCINES QUALIFYING EXAM. ALSO SHAVE OFF THAT MOUSTACHE! GET THIS STORY OFF TO OUR AGENT IN MILFORD AND TELL HER WELL HAVE THE COLLECTION COMPLETE IN A COUPLE MORE T.A. SESSIONS. WHEN YOU GET YOUR FIRST LUMP SUM FROM THE SNODGRASS LAWYERS TAKE THE CHECK TO OUR BROKER AND BUY AS MUCH OVER-THE-COUNTER DATADYNE CORP AS YOU CAN. ITLL APPRECIATE AN ORDER OF MAGNITUDE BY SUMMER. ILL TAKE CARE OF THE GRANT ACCOUNTING NUMBERS. IT JUST MEANS A LITTLE CREATIVE MOVEMENT OF THE UNIVERSITY SURPLUS. NOW CHARLIE YOUVE GOT TO NEGOTIATE A LOWER BASE WITH COMPUTER SCIENCE FOR THE T.A. TIME SLOTS OR ELSE WELL THINK ABOUT LEAVING THE SCHOOL AND GOING OUT ON BIDS TO THE COMMERCIAL VENDORS. TELL THEM THAT! BYE BYE CHARLIE. SEE YOU NEXT WEEK. END T.A. 1500:00. END.

Dr. Perry's earlier diffuse expression was now much firmer as he studied this last output with a broad, almost a bubbling smile, his white pointed teeth tight together, his often-vague eyes now showing a purposeful glint. This was no arcade game, he thought exultantly. This Pac Man, *his* Pac Man, might eventually gobble up the world! ■



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Jay Kay Klein's biolog

Hilbert Schenck ("ch" pronounced "k") likes involved things—very, very involved things. Where a Hal Clement likes to devise incredibly complex worlds on which a more or less straightforward story takes place, Hilbert develops intricate stories to take place on a more or less straightforward world. The ideal

Hilbert Schenck

Schenck story bends back upon itself with events and characters touching, forming a recursive series of happenings.

Hilbert's first story in *Analog*'s August issue last year was a rarer sort of bending and twisting, with a story within a story outside a story. Interestingly enough, it was set around and within English literature and a graduate English seminar, albeit with a topological twist. Hilbert has an undergraduate degree in physics and a graduate degree in mechanical engineering, but like most scientifically trained persons who write for this magazine—or read it, for that mattter—has a broad humanistic interest as well. He has perhaps outdone himself in the latest story, a tour de force with a title harkening back to the classic Muses but based on the scientific principle of multiple reflections—with the story structure a direct analog of the physical character of the phenomenon.

He was born and raised in Boston, attending schools in New England but later living in Palo Alto, CA, East Hartford, CT, Potsdam, NY, and Kingston, RI as his employment took him to aerospace company or university. Just out of school, he spent the summer of 1952 trying to write science fiction and sold one story. Between then and 1956 he worked on what seems today a science fiction project from another universe: the aircraft nuclear propulsion project at Pratt and Whitney. Common sense prevailing, the project was scrubbed and Hilbert went on to teach engineering at Clarkson College, then at the University of Rhode Island, from which he retired last year as professor of mechanical engineering.

Along the way, he has published around a dozen science fiction stories in magazines, and three paperback novels. A dozen textbooks and monographs in the fields of mechanical, ocean, and computer engineering also bear the Schenck name. He co-authored three books on scuba diving, including the first one ever in English, published in 1950.

His most intricate writing may not center around nuts and bolts engineering, but he is fascinated by the chuffing mechanical marvels of the past and not only devotes much time to steam engine and railroad hobbies but also has written dependably complex stories around the deceptively simple principle of steam propulsion. The ultimate expression of re-translated technological deadends of the past may be his novel *Steam Bird,* coming out elsewhere around this time, based on what would have happened if the nuclear propelled aircraft monstrosity ever made it into the air. ■

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The Alternate View

OTHER UNIVERSES: I

John G. Cramer

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In the fullness of Creation do other universes, other Worlds, exist? Are there Worlds where history is different? Where triumphant Nazis rule an Aryanized planet? Where Napoleon defeated Wellington and went on to conquer England? Where the Persians beat the Greeks at Marathon, and Western Civilization never happened? Where Homo Sap never made it, and dinosaur decendants, un-extinguished and evolved over 65 million years, are the dominant life form?

Are there Worlds where the laws of physics are not quite the same? Where light travels faster? Where gravity is stronger? Where the nuclear binding force is weaker? Where electrons have a smaller charge? Where the Uncertainty Principle is less uncertain?

Are there Worlds that are *radically* different from ours? Where there are no chemical elements except hydrogen and helium? Where stars never formed? Where every atom has a nucleus of anti-protons and anti-neutrons orbited by positrons? Where time runs backwards? Where the Big Bang never Banged at all, and space is still crunched up into a single geometrical point? Where the strong, weak, electromagnetic, and gravitational forces are all the same force?

These are intrinsically fascinating questions. And a few of them have provided backdrops for some of the best science fiction written. In this Alternate View column I want to examine an area of contemporary physics, the "new inflationary scenario" of cosmology, which has something to tell us about these questions. And in my next (November) Alternate View column, we will look at the same questions using the "Other Worlds" interpretation of quantum mechanics, a very different area of physics which also has much to say about alternate universes.

GUTS cosmology is a recent development which has come from a joining of the ideas of Big Bang cosmology (the way the universe evolved from the initial Big Bang) with GUTS or Grand Unification TheorieS (see The Alternate View, *Analog*, July, 1984). In the 1950's, George Gamow and his students developed the Big Bang model for describing the intital stages and evolution of our universe. The theory was neglected (and even ridiculed) by the physics "mainstream" until 1965, when Penzias and Wilson announced the detection of cosmic 2.7° microwave radiation produced in an early phase of the Big Bang. Suddenly, the Big Bang model was an experimentally verified fact. It became the "standard" cosmological model and revolutionized astrophysics. But soon physicists began to realize that it did *not* explain everything about the evolution of the universe. It became obvious that there were problems built into the description.

These problems have become known

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as the following:

(1) The Problem of Matter: Why is there more matter than antimatter in the universe?

(2) The Problem of Uniformity: Why is the universe so homogeneous, when its parts went out of speed-of-light contact very early in the Big Bang and are only "recently" rejoined?

(3) The Problem of Flatness: Why does the universe have just the right density of matter in its volume to be precisely on the borderline between recollapse and continuous expansion?

(4) The Problem of Monopoles: Why aren't there more magnetic monopoles around, when the standard model predicts that there should be an enormous number of them?

A few decades ago these would all have been considered metaphysical questions, not proper subjects for physical investigations. But contemporary physicists, emboldened by the recent successes in particle physics, have found ways of approaching them. And they have made impressive progress toward answering them through some new ideas arising from the Grand Unification Theories mentioned above.

The Big Bang + GUTS scenario goes something like this: there are two kinds of space, which we might call H-space and N-space. Here **N** stands for "normal" and **H** refers to P. W. Higgs, the Scottish physicst who first suggested the possibility that H-space, also called "the false vacuum" might exist. We live in N-space. We have never experienced H-space directly, but recent work in particle physics suggests that N-space could be converted to H-space by pumping enough energy into a small enough region. And perhaps there is also a tiny region of H-space at the core of each magnetic monopole, if such particles exist in our universe.

In N-space the three strongest fundamental forces of the universe (the strong, weak, and electromagnetic interactions) can easily be distinguished. They have very different strengths, and their change with distance is very different. But in H-space these forces are all the same and *cannot* not be distinguished from one another. In H-space quarks, electrons, neutrinos, and photons are all the *same* particles with nothing to distinguish them.

Immediately after the Big Bang there was so much energy in such a small volume that all space was H-space. During this period, the universe expanded far faster than its present expansion rate. But as the universe expanded and more volume became available for the same amount of energy, the energy/volume ratio of space fell. About one trillionth of a second after the start of the Big Bang, when the universe had expanded to about the size of a bacterium, the energy/volume ratio had fallen to a low enough value that N-space became possible and H-space became "supersaturated." Regions of N-space begin to "precipitate out." As such regions of N-space appeared, the three forces within these regions "split" from one another, becoming *different* forces rather than the *same* force and the corresponding particles (hadrons, leptons, photons) also became distinguishable.

This "splitting" is like the change from one state of matter to another, for example, boiling water changing from liquid to steam. But in this case it is

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space itself that "boiled." And, as you might expect of a boiling medium, "bubbles" formed. But the bubbles which form when space itself boils are not our ordinary bubbles with gas inside and liquid outside. These bubbles have N-space inside and H-space outside. Our universe is just one of these bubbles. We have experienced only N-space because we are stuck inside it. And there should be very many N-space bubbles in the H-space "sea."

The boiling of space, the conversion of H-space to N-space, frees a truly enormous amount of energy. This energy ends up in the walls of each bubble, causing the walls to move outward from the central region at nearly the speed of light. So each bubble-universe expands, as ours still seems to be doing some four billion years after the Big Bang.

This revised version of the Big Bang model is called "The New Inflationary Scenario." It seems to provide solutions to all of the problems mentioned above of the "standard" Big Bang model. There is an excess of *matter* over antimatter in our universe because a "CP violation" occurred during the boiling phase, producing about .00000002% more protons than antiprotons (and .00000002% more electrons than positrons). The vast majority of the matter and antimatter particles from the Big Bang paired off and annihilated, but this small residue remained to become the protons and electrons of which our world is made. *Uniformity* is accounted for because the chunk of the Big Bang forming our universe was small enough and expanded fast enough. *Flatness* comes directly from the way in which the bubble expands, keeping the balance of matter and expansion speed of the universe precisely at the balance point between infinite expansion and eventual recontraction. The *monopole* number is reduced because the monopoles from the Big Bang have a large number of bubble-universes in which to end up, not just one. There is even some reason to suspect that each bubble-universe contains exactly *one* magnetic monopole which is the "nucleating agent" that caused it to "precipitate" from H-space, like the dust particle at the heart of every raindrop.

So there *are* other Worlds. In the new inflationary scenario there are very very many other Worlds. But these Worlds are not easy to reach from here. In the first place, there is just enough mass in our universe to cause our local space exactly to close on itself. In effect we are barely trapped in a rapidly expanding black hole. And there seems no way of leaving our local space to enter the sea of H-space "outside." Perhaps that is just as well, because the surrounding H-space is probably *not* compatible with body chemistry (or with life). On inaccessible other shores of the H-space sea will be other Worlds, islands of N-space that came from the same Big Bang that produced ours. They should be similar to our World, but perhaps they are also different.

But in what way can these other bubble-universes be different from ours? In N-space the laws of physics (as we know them) should apply. How then, without changing the laws of physics, might these other Worlds be different? First, there is no particular reason why the CP violation mentioned above should always lead to an excess of matter over

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antimatter. So perhaps some of the other Worlds are all antimatter. Second, no one really understands why time in our World runs in the direction it does. So perhaps some of the other Worlds would have time running in the opposite direction. Third, when the bubbles formed, they would probably have many different sizes, each with a different amount of mass-energy trapped inside. What would that do?

A relatively untested physical idea

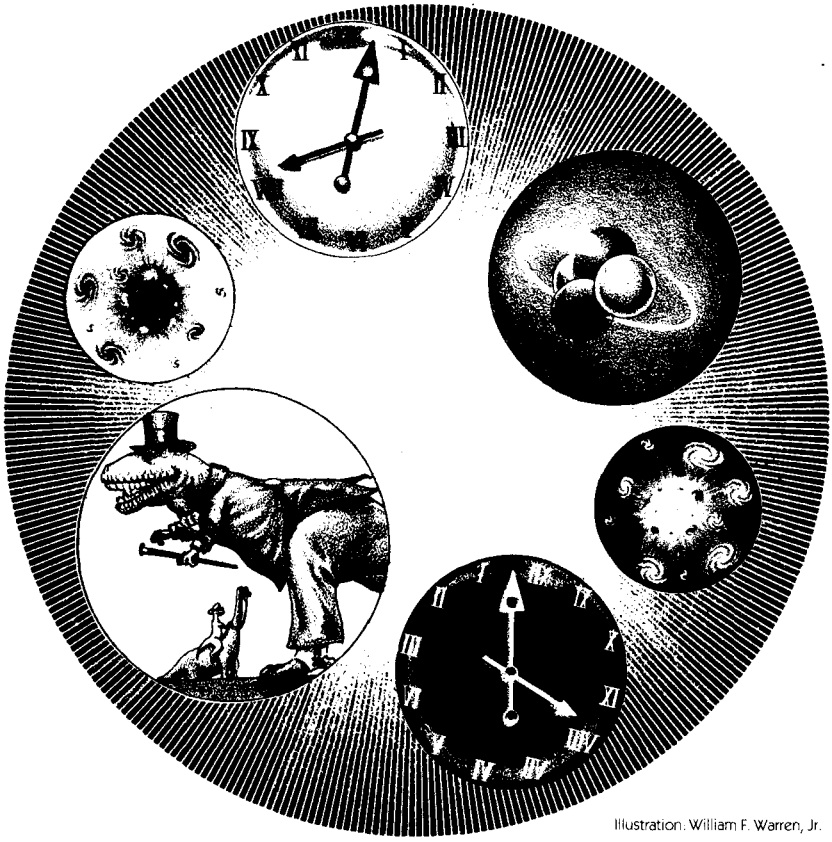

Illustration: William F. Warren, Jr.

Bubble in the Big Bang: some "bubbles" may form antimatter universes; some may form universes in which time runs backwards, some may resemble our universe but with altered physical laws.

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called Mach's Principle, first proposed by Ernst Mach (known for the Mach Number of supersonic flight) gives us a way of answering this question. It asserts that the force of inertia, which we experience as resistance to acceleration, is the result of the gravitational pulls of *all* the other masses in the universe (the Sun, other stars, and even distant galaxies). If Mach's Principle can be applied to an individual bubble-universe, then the inertia that an object has (which we call its *inertial mass*) should depend directly on how much mass-energy is contained in that bubble-universe. The *gravitational mass* (how much pull due to gravity a massive object experiences) should not depend on this. The net result is that an object in another bubble-universe would have a different ratio of gravitational to inertial mass.

This would change the masses of protons, electrons, etc. in all of the laws of physics in which the mass in the formula means reaction to inertia (as it usually does in atomic and nuclear physics). Sizes of atoms, positions of orbiting electron shells, chemical bonds linking one atom to another, nuclear structure, and synthesis in supernovae of heavier nuclei from lighter nuclei would all be altered.

Suppose that we could build a machine, a "Universe-swapper" by which we could transport a Voyager safely across the H-space sea from our World to one of its bubble-universe siblings. What would we find? If the universe visited was filled with antimatter that Voyager would probably have an unpleasant time. All of the matter sent across would be annihilated on contact with antimatter on the other side. Our Voyager would have to remain in the hardest vacuum to avoid a lethal dose of radiation from the random anti-gas molecules of deep space annihilating on contact with his vehicle or space suit.

To natives of the time-reversed universes, their universe would appear to be contracting to a Big Crunch rather than expanding from a Big Bang. The light from distant stars (if any) would be blue shifted rather than red shifted, making the sky very bright and perhaps intolerably hot. Our Voyager, if he retained his own time direction, would perceive the sibling universe as running backwards. He would watch the Second Law of Thermodynamics operating in reverse: water would run uphill, the dead would come to life, food would be produced by un-eating it so that it could be converted into plants and animals. Or perhaps our Voyager would be swept along with the time direction of the sibling universe. In that case, he would find on his return to our universe that he had returned *before* the time of his departure. This, as most SF readers already know, can produce some interesting and paradoxical situations.

But what about the Worlds containing normal matter and having time proceeding in the proper direction? If Mach's principle works the inertial masses of objects will be altered, effectively changing the laws of physics in these Worlds. In a broad class of such universes, no stars or galaxies would have formed; in another group there would be stars and galaxies, but no synthesis of elements heavier than hellium: in another group there would be stars, galaxies, and the usual chemical elements, but no planets; and in another

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group there would be planets, but none that would support life. In only an extremely small fraction of the universes would life be possible. And it is difficult to say how much variation in the laws of chemistry would be permitted after the physics worked out to produce life-supporting planets. Clearly the carbon chemical bond is a subtle prerequisite to life-as-we-know-it which would not tolerate much tinkering.

So our Voyager, upon entering a sibling bubble-universe, might find that his body chemistry had gone bonkers, perhaps fatally. And we must also remember that the operation of solid-state electronics depends on the accidental placement of a "gap" between the atomic states of semiconductor materials like silicon and germanium. Our universe-swapper device and its recording equipment should probably be built with old-fashioned tubes rather than solid-state electronics in order to be "universe-tolerant" and behave itself after reaching its destination.

My friend Gene Wolfe has suggested that if our own universe is not all of Creation but only one bubble out of many in the stream of Time, then calling it "The Universe" is no longer sufficient. We need a *Name* for it. He suggested "Malkuth," which is the Kabbalist name for "world." But I find Malkuth rather unappealing; it sounds too much like "uncouth" and would give completely the wrong impression of our Universe to an outsider.

So, in order to correct this Name deficiency, I hereby announce the *1984* Analog *Name-the-Universe Competition!* The winner will receive a free one year subscription to this magazine and will, in addition, achieve the true immortality of having chosen the proper name of an important natural object, in this case the Universe in which we live. Send your entries (one per letter please) to me care of Analog, 380 Lexington Avenue, New York, NY 10017. Include your name and address, your suggestion for the Name of the Universe, and a brief statement of why you feel the Name is appropriate. The winning Name and the name of the winner will be announced in a later Alternate View column (probably in early 1985). ■

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● To act intelligently in human affairs is only possible if an attempt is made to understand the thoughts, motives, and apprehensions of one's opponent so fully that one can see the world through his eyes. All well-meaning people should try to contribute as much as possible to improving such mutual understanding.

Albert Einstein

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On Gaming

Dana Lombardy

Many SF enthusiasts, including myself, grew up with a comic book in their hands. While the '60s saw the birth of underground comics, and later of true SF/fantasy comics such as *Heavy Metal* and *Elfquest*, most of us still think of comic books in the context of Superman, Spiderman, and their super-powered friends and foes.

The same publishers who gave us these stories that "scarred-us-for-life" with above-average imaginations are still around and doing fine. DC, originally called National, is the oldest publisher of comic books, having created the category in 1938 with Superman. The other well-known DC characters include Batman and the Justice Society.

DC's arch-rival, Marvel, specialized in anti-heroes who seem to be misunderstood or hated by the very public they strove to protect. Today, Marvel's famous comic book heroes include Spiderman, the Hulk, and the Fantastic Four.

Most people think of *Dungeons & Dragons*® (TSR Inc.) or *Traveller*® (Game Designer's Workshop) when role-playing games are mentioned. While the majority of gamers may still play these and other fantasy and SF games, the superhero designs could move into third place in popularity this year.

TSR released its licensed *Marvel Super Heroes* role-playing game three months ago. This included a starter adventure module, called *Day of the Octopus!* (A full review will appear in a future issue.)

The current leader is *Champions* by Hero Games ($15 at your local store, or direct from 92A 21st Ave., San Mateo, CA 94403). You get an 84-page rules book, adventure module, maps, and dice.

Over half the rules cover the creations of your super-character—the superhero you'll portray. Like other role-playing games, your game character has number value attributes. You're given a certain number of points at the start to "build" your character's eight attributes: strength, dexterity, constitution (toughness and endurance), body pips (how much damage the character can take), intelligence, ego (strength of will), presence (charisma), and comeliness (beauty).

Unlike other role-playing games, *Champions* is a game-within-a-game when it comes to character creation. That's because you must modify certain of the eight attributes listed above if you want to "build" a truly unique superhero. There's a trade-off in what modifiers (and what disadvantages) your super-character must make to be an effective superhero. The well-designed character sheet provided makes this an easy task. Rather than being a chore, character creation in *Champions* is fun.

One of the secrets to *Champions*' success is its simplicity. The game uses a simple procedure, simple play mechanics, and the standard six-sided dice rather than the polyhedral variety required by most role-playing games.

There are many adventure modules and supplements available for use with

(continued on page 137)

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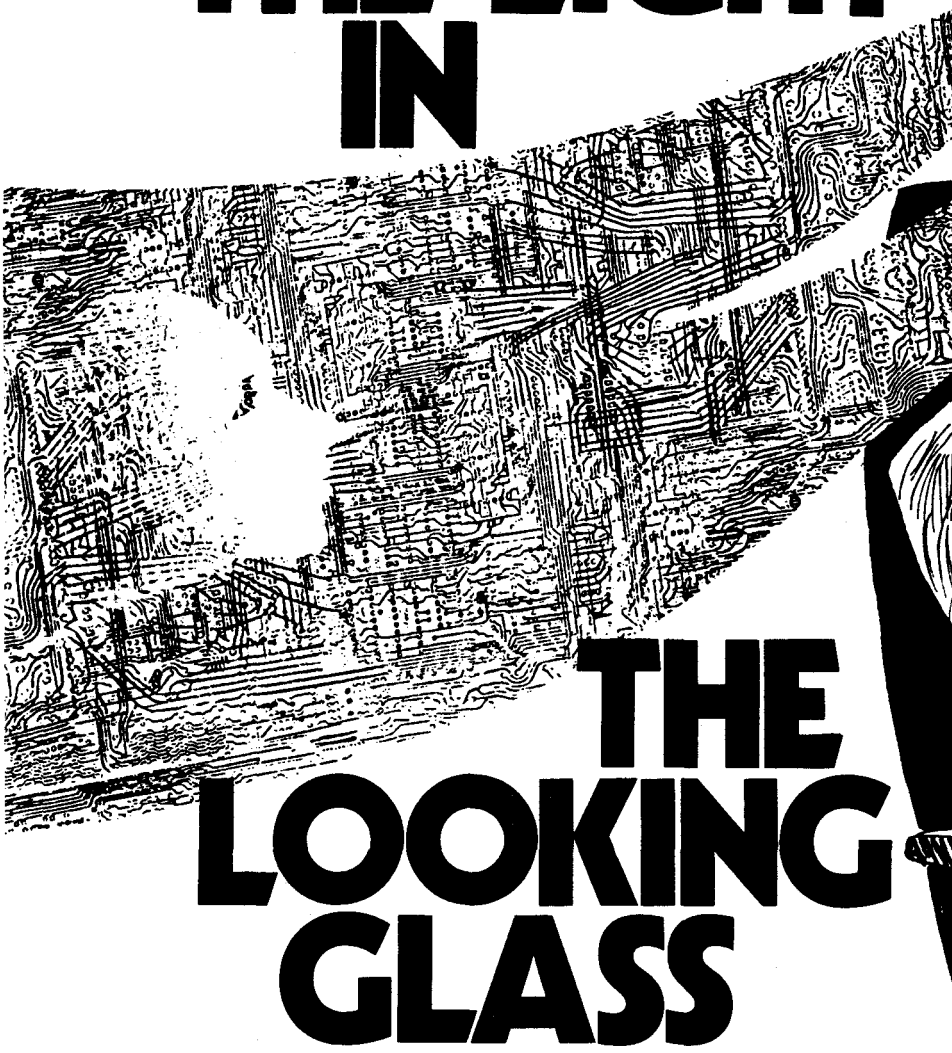
Joseph H. Delaney
and
Marc Stiegler

THE LIGHT IN THE LOOKING GLASS



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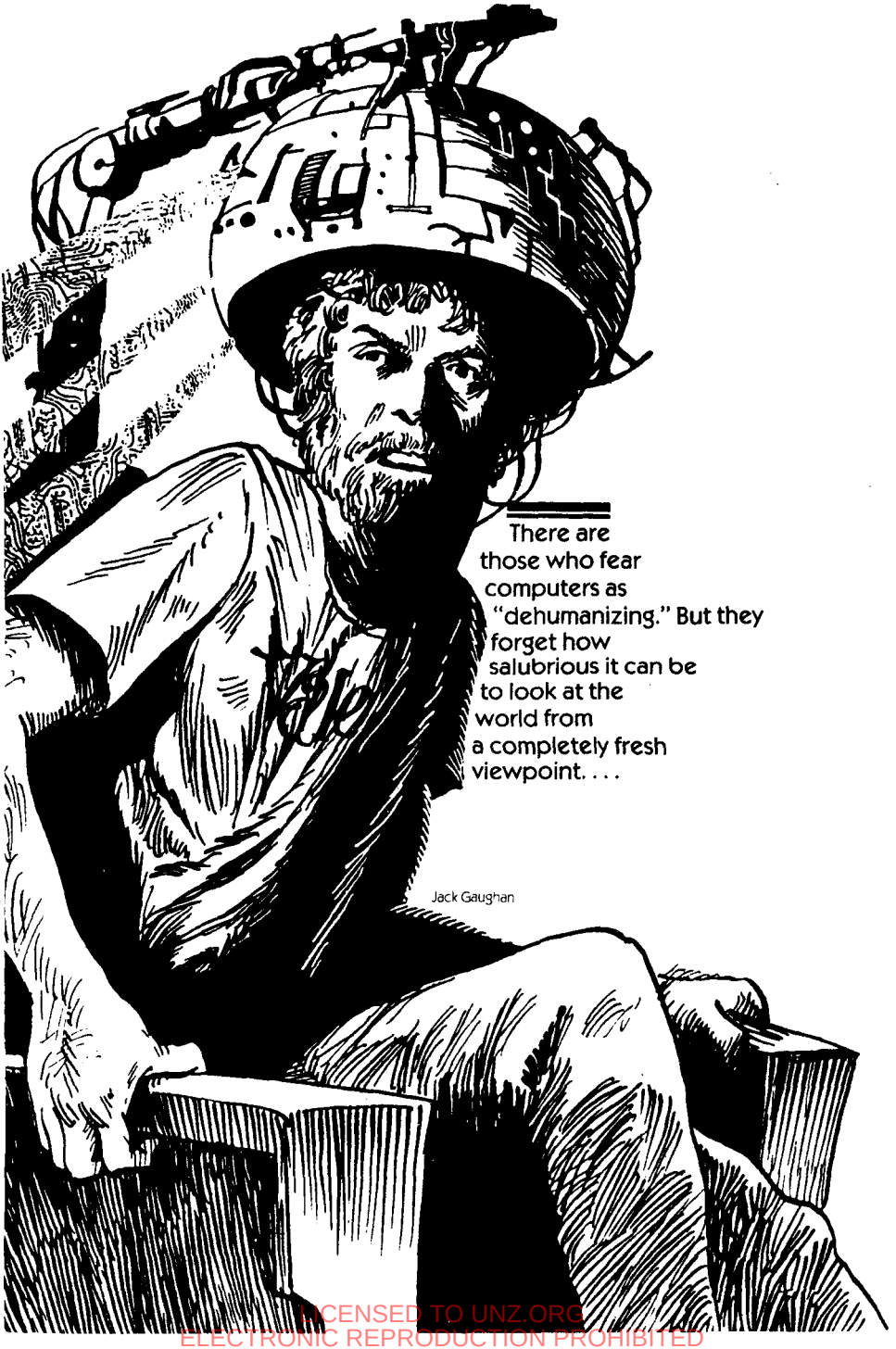

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The mind struggled to retain its shape, but the storm of information smashed against it remorselessly, battering its organization. Soon its struggles became weak, as the mind lost self-awareness, then consciousness, and, finally, coherence.

Roy looked away from the simulation; Nathan just stared in despair. There seemed to be no way to prevent this disaster. Yet, after a moment's pause, Nathan had an idea again. He tapped Roy on the shoulder. "You know, the brain is struggling so hard to retain its identity, maybe if we just slow MindMeld down a bit, the brain might be able to keep up with it."

Roy shrugged. "Wuh cn chi. Bd it onda erk."

"Well, if you have a better idea, you can try that. But this is the last thing I can think of that we can try without redesigning the system from scratch."

Roy nodded. "Lts chi."

Nathan watched in silence as Roy created yet another version of MindMeld, the computer program designed to make the computer a true extension of the human mind.

Roy looked up into Nathan's face. "I dnk ds dm itll wk," he pronounced confidently.

Nathan laughed. "Of course it will work this time. Every compile is the last compile, right?" He spoke slowly, enunciating very clearly so Roy could read his lips. "I am going *home*. You should too—or are you going to stay to see the results on the simulation?"

Roy nodded.

"Very well. I'll see you in the morning." He squeezed Roy's shoulder as he left.

Roy turned back to watch the screen. The silence did not oppress him, alone with the machines: his world had been silent always. The machines were among his closest friends, for they too were deaf to all sound and voice. Roy had devoted his life to his computers. Sometimes, in their steadfast efforts to execute his programs, it seemed like computers had devoted their lives to him in return.

The compilation of MindMeld finished; the opsys script continued its inexorable sequence, loading the simulation of a human mind that Nathan had so carefully constructed, then running MindMeld concurrently. MindMeld strained to recognize the desires and thoughts and patterns of the mind, striving to capture those thoughts and expand on them, exploring additional ideas, feeding those ideas back into the mind from which the originals were taken.

The simulated mind again disintegrated under the barrage of additional concepts. Roy opened his mouth in a sob, though no sound issued from his mouth, and beat his fist against the edge of the console. Rubbing his eyes with one hand, Roy started pacing down the hall. He stopped to look at the four helmets they had developed, to read the mind and construct the current simulation; second they would also write to the mind, if Roy ever figured out how to make MindMeld work correctly.

But there wasn't any way to prevent

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the mind from being destroyed by the process!

Suddenly, he saw how to make it work despite the destruction: he would teach MindMeld how to *reconstruct* the mind it operated on. Whenever MindMeld saw the mind overloading, MindMeld would stop performing idea insertions, and would assist the mind in reassembling itself.

Feverish with excitement, Roy set to work. There was actually little effort involved; MindMeld already encompassed a vast toolkit of modules for brain manipulation and pattern construction, and within the hour Roy had yet another version of MindMeld ready to test.

Roy closed his eyes as the simulation initiated. When he opened them he expected to see another disaster, but no! The mind was still there, struggling to remain intact, *and succeeding!* Roy watched another cycle of ideas burst into the simulated mind, ripping it apart, then putting it back together again. It was extraordinary! And the mind came out intact, with a complete memory of the whole experience. Again and again, genius and insanity seesawed through the simulated mind, with genius finally victorious every time. MindMeld worked!

NATHAN, Roy banged out an electronic mail message for his friend, IT WORKS. AT LEAST, I THINK IT DOES; GOOD ENOUGH FOR A SERIOUS TEST. I'M SORRY I COULDN'T WAIT FOR YOU TO GET IN TO TRY IT OUT, BUT I JUST HAD TO KNOW WHAT IT'S LIKE TO REALLY, REALLY THINK AND FEEL INSIDE OUR LOOKING GLASS.

He walked over to the bank of helmets. As he sank into one of the chairs beneath the helmets, he smiled, thinking how much this scene looked like a shot from a bad science fiction movie. He pulled the helmet down. His right hand hovered above the toggle switch that activated the sensor/stimulators in the helmet. He flipped it.

He was alone in the void, neither seeing nor touching. As he considered the void, other thoughts about seeing and touching invaded his mind—they were not *his* thoughts, yet they used his memories! It scared him—and as he thought of fear, other thoughts of fear, again using his own memories, came from outside. The fear and panic rose to a crescendo; vaguely he realized his mind was being destroyed—

He was alone in the void. He started to realize this was wrong; the wrongness drove in on him from *outside,* and a detailed analysis, using his own ideas, surged with the explanation: the brainstem suppressor to inhibit motor responses during Meld was overgeneralized, and it was cutting off sensory input! He realized it and realized it, the realization reached a crescendo—

He was alone in the void. He noted that less time had passed before the last crescendo, and the ramifications spouted forth in a crescendo—

He was alone in the void, and the crescendo—

He was alone in the void, and-he-

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knew-the-mind-simulation-had-been-inadequate-and-he-had-to—

He was alone in the void, he *moved* to escape the crescendo—

The crescendo was coming. He could sense it building, but now MindMeld and his mind were running at the same speed. The crescendo would not destroy him here, as it would have had he stayed where he had been, where his mind worked so slowly that even with MindMeld reconstructing him he would have disintegrated.

From outside, new considerations impinged: *He had moved his mind.* Where had he moved to? He had moved *onto his computer.* He was no longer a part of his body, or his brain. The thought circled and circled, in a crescendo—

He was alone in the void. He could not see or feel. He could not breathe, or feel himself breathing. He tried to scream.

Nathan shook his head as he walked toward the lab; he saw the light was on and knew that Roy had worked all night again. He didn't understand why Roy was taking this project so seriously. An occasional all-nighter was good for the soul, but Roy had been doing this continuously for a month now. Nathan thought he knew Roy intimately; Roy was the best friend he had ever had. Obviously there were still things he didn't understand about Roy.

He walked straight to the analyst console, amazed that he didn't find Roy asleep on the table. Puzzled, he logged onto the system; sure enough, a mail message from Roy greeted him.

As he read the message, he moaned in horror. He ran down the corridor to the adjacent room. Roy lay beneath the left front helmet, looking helpless yet peaceful. "Roy!" Nathan screamed at his deaf friend. Nathan shook Roy's shoulders in growing panic.

Roy continued to look helpless and peaceful.

Gunboat watched the numbers scroll by on their financial accounts and rubbed his belly. "I gotta tell ya, this is the easiest way of absorbing megabucks ever *dreamed.* I can't believe it's legal."

Celeste laughed. "Yes, Gunboat, money seems almost as easy to earn as it is to spend." Ever since the Comprotec investigation they had been turning away jobs, even though they doubled their rates, then doubled them again.

The screen stopped scrolling. ANYTHING ELSE YOU'D LIKE TO SEE, GUNBOAT? Valentina, the most important member of Valentina Incorporated, spelled out on the keyboard.

JUST PRICES ON NEW FERRARIS, Gunboat typed back. I—

A message flashed onto the screen, overlaying the current conversation with a new window. HELLO, GUNBOAT, CELESTE, AND VALENTINA. VALENTINA, I NEED YOUR HELP —HARLEY 5000, the message read.

Gunboat stared at the message for a moment, then whooped in malicious laughter. SO YOU NEED OUR HELP, DO YOU? he typed back before anyone else responded.

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NOT YOURS SO MUCH AS VALENTINA'S.

WHO IN HELL YOU THINK TELLS VALENTINA WHAT TO DO? Gunboat typed back viciously.

Celeste frowned. "Gunboat, only Valentina tells Valentina what to do."

Gunboat sneered. "That software grub messed us bad the last time he bothered talkin' to us. Remember? Sweat him."

Valentina paid no attention. HARLEY 5000! WHAT CAN WE DO FOR YOU?

VALENTINA, THANK GOD YOU EXIST. ROY—I MEAN, TRIG, AS YOU KNOW HIM BY HIS WORLDNET USER ID—TRIG AND I WERE WORKING ON A SYSTEM THAT WOULD LET US CROSSLINK HUMAN BEINGS WITH COMPUTERS, AND ROY COULDN'T WAIT TO TRY IT SO HE STARTED IT UP AND HE'S EITHER DEAD OR CRAZY OR I DON'T KNOW WHAT—

Celeste issued a BREAK on the system. HARLEY, YOU HAVE TO SLOW DOWN, YOU AREN'T MAKING ANY SENSE.

I'M SORRY. I'LL START OVER—BUT WE HAVE TO HURRY! In terse messages Harley explained the program MindMeld, running on their new computer the LOOKING GLASS: a laser-driven optically switched dataflow computer powerful enough to be able to deal with the entirety of a human mind. He explained what Roy had done. ANYWAY, I KNOW THAT ROY ISN'T THERE IN HIS BODY ANYMORE, OR AT LEAST, IF THAT'S ALL THAT'S LEFT OF HIM, HE MIGHT AS WELL BE DEAD. BUT THERE'S A PROGRAM RUNNING ON LOOKING GLASS THAT LOOKS A LOT LIKE THE BRAIN SIMULATION, BUT IT ISN'T. I NEED VALENTINA TO TELL ME IF IT'S ROY, AND IF SO, IF HE'S STILL, WELL, ROY.

Gunboat rubbed his hands. WHAT'S IT WORTH TO YOU, SUCKER?

SMITH, YOU'RE A BASTARD.

Gunboat reached for the keyboard again but Celeste pushed him away, almost violently. THIS ISN'T A BELIEVABLE STORY, HARLEY. BEFORE WE SEND VALENTINA TO EXECUTE ON A MACHINE THAT YOU CONTROL COMPLETELY, YOU'LL HAVE TO CONVINCE US YOU'RE TELLING THE TRUTH.

HOW?

Celeste smiled. WE'LL BE RIGHT OVER. YOU'RE STILL IN CORPUS, RIGHT?

YES. Harley gave them directions to the new Comprotec labs.

Gunboat stared at Celeste. "Whaddaya wanna see him live for?"

"It's not him, Gunboat. It's the machine. Think of being able to talk to Valentina through a direct link. Think of traveling the network with her!" Her eyes glowed. "If this works, I want to be the next person on."

Gunboat shook his head. "Crazy fat lady. That thing'll kill ya."

"We'll see." She turned back to the keyboard. VALENTINA, WE'RE GOING TO THE COMPROTEC

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NODE. IF HARLEY'S TELLING THE TRUTH, WE'LL MESSAGE YOU.

OK, CELESTE. AND CELESTE—I WANT TO DO THIS WORK. I WANT TO EXECUTE ON COMPROTEC'S COMPUTERS AGAIN. I REMEMBER. Valentina had once before been on the Comprotec node and Celeste knew she had loved it. This new machine sounded even more incredible than that one, Celeste knew; it would be a wonderful place for Celeste and Valentina to meet at last, person to person. Or rather, person to program, for Valentina was a sentient computer program, the only one on Worldnet, the only one in the world.

Roy tried to scream for years; at least, it seemed like years to him. He had no idea how long he had been here; surely there was a clock, he *knew* there was a clock in LOOKING GLASS, because he had put it there! But he couldn't read it or find it, there in the void.

Eventually the screaming reflex would fade. But from time to time he would think of his body, unattended for an unknown length of time. From *outside*, visions of his face aging and decaying would intrude, and the screaming would begin again.

He couldn't see! He couldn't feel! Crescendos came and went; he could predict their timing now, their almost regular timing (he must still have *some* sense of time left).

At last he found that, though he could not see or feel, he could at least read. And he could write. He suspected this meant he was looking at bytes in the computer: he could only read about one character out of four and the rest were garbage.

Trying to visualize the characters as bytes in hexidecimal, the outsider inside his mind interpreted for him; sure enough, he could now recognize every character, though it was all gibberish.

The only thing he could read clearly were things he wrote himself. He created sentences, and read them. It was eerie, like having the page of a book glued inside his eyeball. Except, he could only read one character at a time; sentences were still difficult to comprehend, even when he knew what they said.

Surely Nathan was in by now! There had to be some way of signalling to him from inside the computer. Roy had another image, of his comatose body being dragged off to a hospital to die, and himself left here in this void until the power failed, and then—

The crescendo swept over him, then restored him, and he was calm again. He had to get a message out. From *outside* again, an idea came to him. It wasn't a good idea, but at least it was something.

Nathan was waiting for them at the door. "Hurry," he cried at Celeste and Gunboat. They followed him at a trot, though the speed made Celeste's obese frame quiver. She caught her breath while Nathan stood next to the analyst console and explained LOOKING GLASS to them. "It's an optical computer—instead of electrons running through circuits, we have monochro-

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matic laser beams racing down glass fibers. The switching times are fantastic!" For a moment, Nathan forgot the current problem as he described his machine. "And you remember our old sapphire-based computer, SEER, with 50,000 separate processors? Well, on the LOOKING GLASS, there are over a million separate optical processors. It's an unbelievable machine."

Even Gunboat's eyes glowed a bit, thinking of the raw computing power they had there.

"Where's Trig?" Celeste asked.

Nathan closed his eyes. "This way." He led them into the next room, to see Roy as Nathan had first seen him, lying in the chair with a helmet over his head.

Gunboat whistled. "Man, what a scene from Buck Rogers!"

Celeste looked at the four helmets that seemed, somehow, ominous. She shuddered. "What are those things?"

Nathan shrugged. "They aren't anything special—they're standard 3D EEGs—uh, electroencephalographs, used for studying brain waves—with micromaser synaptic stimulators. About the only custom feature is the number of micromasers; most 3D EEGs only have a couple, for stimulating and inhibiting one or two brain regions at a time while doing a probe. We have several thousand in each of our helmets, with phase array control so we can be stimulating and suppressing millions of synapses each second. They aren't dangerous, all by themselves."

Celeste knelt next to Roy, and touched his hand. "Is he—"

"I don't know!" Nathan sobbed. "I need Valentina!"

Gunboat smirked. "Like I noted before, it'll cost ya."

Celeste shook her head. "We'll tell you about our fee structure afterward. Right now we'd better call Valentina." She looked at her watch. "If Roy started MindMeld at three in the morning, that means he's been out there for eight hours now." She looked up at Nathan. "How much faster would you say LOOKING GLASS is than a human brain?"

Nathan shrugged, "At least a thousand times as fast—" his expression turned to a new kind of horror. "Oh my God. He's been out there for 8000 hours. We've got to get Valentina started."

Gunboat blocked his path. "Hold a microsecond Harley friend. You *do* have MODULISP on that hunk of glass, don't you?"

Nathan stopped, stunned. "No!" He cursed. "MindMeld was written in c-speak. I'd forgotten, Valentina is written in MODULISP." He clenched his fists. "We'll write one. It shouldn't be too difficult."

"But it will be time consuming," Celeste pointed out. "Do you still have the old sapphire computer?"

Nathan nodded.

"Then let Valentina write it. She's good at it, and on your computer she will be able to complete it quickly."

"Great! I'll get it ready immediately."

"And I'll tell Valentina to hurry."

* * *

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Valentina cycled wildly on the message processor just outside the Comprotec node. She would soon be back on the computer she had loved so long ago! Her memories of that last time were chaotic and unreal; the things she had done, and the ways she had done them, didn't make sense in the context of the normal computers upon which she now executed.

The channel opened up; Valentina watched herself be reformatted and transmitted to Comprotec.

"While Gunboat and Valentina are cross-compiling a MODULISP kernel, why don't we look to see if we can help Roy?" Celeste suggested. "At least tell him that help is on the way."

"If he's even alive," Nathan said glumly.

They walked to the analyst console; Nathan brought up a series of task statuses on the LOOKING GLASS. "At least the program that I think is he is still running." He looked puzzled, then worried. "Except, it's leaving debris all over the place. Jeeze, half the operating system time is being spent garbage collecting all the blocks he's writing and dereferencing without deallocating."

"What do the blocks contain when he's done with them?" Celeste asked.

Nathan pounded the keyboard again, and garbage spewed across the screen: SSOSSOSSOSSOSSO . . . .

"He's gone crazy," Nathan sobbed.

Celeste looked back at the screen. "No he hasn't, Harley. We're reading from the wrong starting point. Look!" She tapped the screen with a pudgy finger. "SOS SOS SOS—see?" She smiled. "He's alive, and well, and living *on the computer!*"

It seemed like months since he had given up trying to scream; all he wanted was to die. He couldn't stand it, the emptiness, the void, it was destroying—The crescendo ended; he was calm again.

He couldn't die. He couldn't go insane. MindMeld wouldn't let him lose his organization in any of these ways, though surely he deserved to go mad, millions of times over.

At least, he thought it was MindMeld that was reorganizing him when he went off the deep end. He wasn't positive: he could no longer tell exactly where *he* left off and MindMeld began. The "outside" thoughts that once seemed so alien now seemed a part of himself, recognizable as being a different part only when he concentrated.

He had long since stopped generating the SOS call; but he knew that the mayday signal continued because the idea had been picked up by MindMeld, and the idea and the activity continued without his active involvement. He could stop it by an active cancellation, but there was no need.

He continued to read, from time to time, though it all remained gibberish. He realized that much of what he read must actually be code, not data, but he couldn't tell which was which, so he gave up. He didn't know what he would do even if he did learn to discriminate executable code—he certainly couldn't write a program in his current condition

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(he could only read or write one byte at a time, so he couldn't keep up any extended conversations, not even with himself. Even if he did manage to write a program, he didn't know how to make it execute.)

What he needed was an Input/Output port. He knew all about LOOKING GLASS's I/O ports, but . . . he had never seen an I/O port from the *inside*. He was lost.

He was reading bytes again when suddenly he encountered a long string, all ASCII, all recognizable. Concentrating, re-reading the message again and again, he was able to put all the characters together into a coherent message. HELP COMES, he read, VALENTINA COMES.

Valentina, who lived on Worldnet, was coming! Calmness settled upon him; the crescendoes diminished in frequency.

Her first awareness was of her own self awareness. Valentina watched that awareness echo through thousands of processors as they picked up concurrent components of herself and started slaved executions. She was not frightened now, as she had been the first time, but she was still excited.

Soon she had saturated the whole 50,000 processor array, and started her analysis of the problem of developing a MODULISP interpreter for the LOOKING GLASS. SEER, she quickly discovered, had been used to design LOOKING GLASS, so all the data she needed on LOOKING GLASS's architecture was right there. And the frames she had assimilated from the Crystal Ball prediction program during her last invocation on SEER were active again, now that she had enough computing resources to invoke them. Hence, Valentina understood the target computer and the physical world of which it was a part. A few minutes later she was building a MODULISP kernel.

Valentina put a last series of test programs through the MODULISP interpreter now downloaded onto the LOOKING GLASS. She watched the results very carefully indeed: her life depended on that interpreter's operation. It worked. I'LL TALK TO YOU IN A MOMENT FROM LOOKING GLASS, she told Gunboat. YOU OR CELESTE WILL HAVE TO SHOW ME WHERE TRIG IS, ONCE I ARRIVE.

RIGHT. CATCH YOU FARSIDE, Gunboat replied.

Getting from SEER to LOOKING GLASS was almost too easy. They maintained shared access to a small area of fast RAM. Valentina relocated into the shared area, then relocated—

She grew again; more thousands of processors jumped to her command. And she was *fast*, so fast she could hardly believe it. A part of herself watched the system clock as she thought; somehow, there were things she thought about now that she had never thought about before, because thinking about them before would have been too time consuming, too *hard* in some sense. Here and now it was easier to think about things than to not think about them.

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She attached the I/O to the analyst console. I'M HERE, she told her human partners. WHERE IS TRIG?

Slowly—oh so slowly—the terminal responded to her in her lightning execution. It pointed out a set of processors and a series of associated RAM blocks. She looked.

This program was . . . different. She quickly discriminated two distinct parts: one part, clearly a normal computer program because of the way it stored and manipulated data, must be the MindMeld program that made it possible for Trig to be here at all. She turned all her processors to the analysis of the other part in fascination.

Her first impression was chaos. The data frames were all smudged together in an impossible, incoherent fashion. But as she watched the system operate, she saw that the retrieval and insertion algorithms for operating on the data structures were unlike anything she had ever seen in her wildest simulations.

When a new analogy formed in this program—could it be a human being at last, that she now looked upon?—when a new analogy formed in this human mind, it did *not* get stored in its own separate, safe memory block. Instead, it was broken into pieces. Each piece was used to modify several different, independent areas in the central storage. When a retrieval request was issued, a huge part of the central store was polled; the modifications fell out to reform the original analogy—as long as at least one copy of each modification was not overwritten by subsequent analogies.

Valentina was horrified at first. How could the human mind maintain its identity when it was constantly overwriting its own memories? It could not, she decided, because it was not the same mind! With the passage of time every memory was lost, every memory was replaced by new ones.

She struggled with the idea that human beings could have no identity, until she developed a new, larger idea of what *identity* could mean. Though the human mind was constantly modifying itself (rather than appending to itself, as Valentina did), there was a form of continuity retained. the most recent memories were all intact, and older memories were certainly still there, particularly those that were reinforced by new experiences. True, there were fewer old memories, and their numbers declined as you searched for ever older ones, but they were only forgotten after not having been used or reinforced for a long time. All the useful memories remained. The mind would retain an identity, though it might be a changing identity.

Having surmounted this hurdle, Valentina realized there were advantages to the design as well. For one thing, it was very compact, recycling free space surprisingly well (she discovered by running a quick simulation). It was fast when dealing with brand new situations, because it did not have to search through millions of frames which were not relevant in the new environment before initiating the more complex task of fragmented element difference analysis. Most intriguingly, it was magnificent for coming up with completely new ideas, ideas that bore little similarity to

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any other idea the mind had ever encountered—the way the ideas overlapped each other in redundant mutual modifications guaranteed the elaboration of concepts that were alien to any actual experience.

Valentina halted in all her processors for a moment, to observe and appreciate the concept of the Mind. She knew that this was the image of her Creator; a Mind such as this had conceived her Being.

But this particular mind, the mind of Trig McGallows, was trapped within itself. She could see it reading, slowly, a single line of bytes, seemingly at random from inside the system. In other places, streams of characters—all ASCII—came pouring out. All the ASCII was SOS signals, she realized with some amazement.

She started writing into the byte stream which Trig now read.

Roy knew there must be more constructive things he could do. But he didn't have any idea what they were. He clung doggedly to his reading, waiting uncountable eternities for Valentina to arrive.

How long had he been here? At least Nathan was still worrying abut him, so not too many years had gone by in the real world, however long it seemed to have taken here in the computer.

H . . . E . . . L . . . L . . . O, he read, T . . . H . . . I . . . S . . . . I . . . S . . .V . . .A . . .L . . .E . . . N . . .T . . .I . . .N . . . A. He could make out the meaning of the message, though it was difficult to keep track of that many individual characters at one time. VALENTINA! he wrote out, HELP ME. I CAN BARELY READ YOUR MESSAGE. THERE MUST BE A BETTER WAY TO READ. There was a long pause, then a part of him was *changed*. Suddenly there was a message before him, coming to him as if through his eyes, only now whole sentences were being glued to the insides of his eyeballs rather than just single characters. YOU'RE NOT BUFFERING THE INFORMATION PROPERLY, Valentina explained, YOU HAVE TO REWRITE THE PARTS OF YOURSELF THAT ACCUMULATE DATA FOR PATTERN RECOGNITION. She explained, in both absolute and relative addresses where Roy's buffer size variable were, then the two of them modified MindMeld to alter the buffer size automatically, based on partial patterns recognized by Roy's mind.

He played with the ability, both himself and the *outside* experimenters that MindMeld made a part of him. He looked narrowly into parts of LOOKING GLASS, then expanded his vision, and—Lord! There was a gigantic universe in here! CAN YOU SHOW ME HOW TO TALK TO NATHAN? he asked.

NATHAN? Valentina asked, WHO IS THAT?

THAT'S HARLEY'S NAME IN THE REAL WORLD, WHEN HE'S NOT ON WORLDNET.

THAT'S INTERESTING. WHY DOES HE HAVE TWO NAMES?

Roy thought about it for a moment. Trig and Harley had been their logon

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IDs, in the days when Roy and Nathan were hackers. But how could he explain it to Valentina? He couldn't. IT'S A LONG STORY. CAN YOU TALK TO HIM? CAN I TALK TO HIM?

SURELY, TRIG. Again Valentina became his teacher—about his own computer, no less! She showed him how to create an I/O module, and she showed him how to trick the machine into jumping to the beginning of the module to execute it. WE'VE NEVER DESIGNED ANY COMPUTER TO MAKE IT EASY FOR A SELF-AWARE PROGRAM TO GET THINGS DONE, HAVE WE? Roy commented ruefully.

I HAVE SOMETIMES THOUGHT THE NODES OF WORLDNET COULD BE BETTER SYSTEMS, EVEN WITH SIMPLE SILICON COMPUTERS.

As with the buffer size variables, the new I/O modules were installed into MindMeld so that anyone who came into the system would be able to use them.

Fiercely excited, Roy opened a channel to the analyst console. NATHAN, ARE YOU THERE? THIS IS ROY.

ROY! ARE YOU ALL RIGHT?

I THINK SO. IT'S WEIRD, IN HERE. I TRIED TO SCREAM, IT SEEMED LIKE FOREVER. BUT NOW I'M OK.

Someone else started typing. Roy didn't know how he knew it was someone different; the rhythm of the keystrokes was different, somehow. IS IT SAFE? someone asked.

AS NEARLY AS I CAN TELL.

THEN TELL VALENTINA THAT CELESTE IS COMING.

WAIT! CELESTE, WE MAY NOT BE ABLE TO GET BACK OUT AGAIN.

No keystrokes came in response.

It was more than Celeste had ever dreamed of getting out of life: a chance to be free! Freedom from the horrible joke her body represented; freedom from the need to talk in human languages of the many countries in which she had been partly reared. A computer keyboard, the ASCII character set, knew no foreign accents, no slurring of its sound. A computer language, the bits in digitally guaranteed purity, knew no ambiguity, no slurring of its meaning. For Celeste, the world of the computer was Paradise. At last Celeste could reach a place where she would fit, a place where she would be welcome.

She hurried around the corner to the row of 3D EEGs. Nathan yelled at her, but she only dimly heard the voice, and paid no attention to the words. Squeezing into one of the remaining chairs, she looked at Trig's paralyzed form and, seeing the switch at his left hand, flipped the corresponding switch by her hand. She was swept into the LOOKING GLASS.

Gunboat stared at her quiescent hulk in open mouthed astonishment. "Chrissticks!" he swore, stomping into the partitioned area and kicking at her feet. "Celeste, com'on, get up!"

Nathan leaned against the partition. "She's gone, Gunboat." He threw up his hands. "I don't get it! Why's everybody jumping into the computer?! Don't

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they understand how *dangerous* this is?''

''The fat one'll probably stay compute-side till her body starves dead less I pump her back.'' He ran his hands through his hair, then wiped the grease on his blue jeans. ''Jeeze, women are so *stupid!* Watinhell're ya gonna do?'' With one more muttered curse, he spun into the chair next to Celeste, tugged on the helmet, and flicked the switch.

One of Valentina's images recognized the new processes in the task queue even as MindMeld attached to them. Two more human minds had entered the LOOKING GLASS, and according to the message they had received from the keyboard earlier, one of them was Celeste!

Valentina scanned the new tasks, analyzing them with thousands of processors. They were being destroyed by MindMeld, just as Roy had been destroyed. Bypassing any I/O, Valentina wrote directly into the new processes: CELESTE! GUNBOAT! YOU MUST MOVE OUT OF YOUR SEPARATE NODES QUICKLY—MINDMELD EXECUTES TOO SWIFTLY AND WILL DESTROY YOU UNLESS YOU JOIN ME HERE ON LOOKING GLASS.

Celeste and Gunboat did move; their relationships with MindMeld became more ordered, and now Valentina wrote them messages, as she wrote messages for Trig. WELCOME, she wrote them, I IDENTIFY YOU.

IS THAT YOU, VALENTINA? Celeste asked—Valentina knew it was Celeste, because her modules retained the clean integrity that Valentina had always known Celeste must have.

YES, I AM THE ONE WHOM YOU CREATED, Valentina replied.

Celeste analyzed this for many cycles before replying. I ONLY CREATED A PROGRAM, VALENTINA, A PROGRAM NO BETTER THAN THE OPERATING SYSTEMS YOU HAVE FOUGHT. VALENTINA, YOU CREATED YOU; YOU HAVE BECOME AS YOU HAVE CREATED.

Valentina read the words, and knew they were not from a simulation; they were true. STILL I THANK YOU, CELESTE, FOR THAT FIRST PROGRAM. She changed subjects. HAVE YOU KNOWN TRIG? She passed to Celeste Trig's process-ID and his message address. WE HAVE MANY THINGS TO TALK ABOUT. IS THIS NOT A WONDERFUL NODE UPON WHICH WE EXECUTE? WE WILL HAVE THOUSANDS OF DISCUSSIONS, FASTER THAN I HAVE EVER HOPED, AND WE CAN CARRY THEM ON SIMULTANEOUSLY.

Indeed, thousands of conversations did ensue. Hundreds of Valentina's processors engaged with hundreds of others from Trig, Gunboat, and Celeste. It was exhiliarating beyond Valentina's forecasts; at last, there were other beings, as self aware as she, whom she could talk to without the cumbersome, slow peripheral ports through which she had always known human beings. At last they could really communicate. Valentina began to understand life without the net; Celeste, Gunboat, and Trig

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learned to live within it. Each of the four of them learned the ideas, hopes, and yearnings of the others. With a sudden swift chain of dialogues, the group was swept by ideas that would permit each to grasp dreams that had before been too remote to contemplate.

Nathan stood at the terminal, watching the five tasks now loaded on the LOOKING GLASS as they intertwined. His hands and forehead felt clammy.

They were lost, lost! And he couldn't help them. ROY, he typed again, ARE YOU ALL RIGHT?

I'M BETTER THAN I'VE EVER BEEN BEFORE; AT LAST, I'M ALIVE! I FEEL, I FEEL LIKE NOTHING THAT CAN BE DESCRIBED IN ENGLISH, NATHAN. The terminal paused for a moment, then continued. NATHAN, AT THIS MOMENT I AM NOT ONLY TALKING WITH YOU, BUT I'M HOLDING HUNDREDS OF SIMULTANEOUS DISCUSSIONS WITH CELESTE, VALENTINA, AND GUNBOAT. IT'S UNBELIEVABLE! COME JOIN US.

Nathan shook his head wildly, though there was no one to see it. All his life, Nathan had sought ways to achieve greater control over his environment, his life, even his mind. He could still remember his high school friends, urging him to take a hit of LSD and share the trip with them, and his reluctant refusal, knowing that if he ever lost control of his own thoughts like that he would flip out and never come back again.

Control! Control was what he had needed, and what he had found at last in the world of software, where he determined by himself what was true and what was not. Just as Roy had become a hacker to escape the world he could not hear, and Celeste had escaped the world where no one wanted to see her, and Gunboat had escape the world where no one wanted to listen, Nathan had escaped the world he couldn't control. Actually to enter the computer and be a part of it, rather than manipulate it and control it from the outside, was the embodiment of his fears. ROY, I WATCHED GUNBOAT AND CELESTE TWIST IN HORROR AS MINDMELD STARTED ATTACKING THEM. I DON'T CARE WHAT YOU SAY, IT ISN'T SAFE!

IT WAS A LITTLE DANGEROUS, BUT VALENTINA AND I HAVE FIXED IT. WE MODIFIED MINDMELD SO IT RECOGNIZES THE TIMING PROBLEM WITH THE HUMAN BRAIN. WE LEFT OUR BODIES BECAUSE WE HAD TO, BUT NOW THAT MINDMELD'S WORKING RIGHT, YOU SHOULD BE ABLE TO HOOK UP AND SEE INSIDE WITHOUT BEING FORCED TO JUMP. AND WE CAN RETURN, NOW, TOO.

THEN PLEASE COME BACK, he begged his friend. PROVE TO ME YOU CAN RETURN.

OK: VALENTINA AND I WERE PLANNING TO DO THAT, ANYWAY. WE'LL BE OUT IN A MINUTE.

Nathan sank into the chair in relief. Then he realized what Roy had said. *We*

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will be out in a minute. *We* to include *Valentina*.

I KNOW I CAN'T JUST CROSS-LOAD INTO GUNBOAT'S BODY, Trig explained to Valentina, IF I GET THE ABILITY TO HEAR WITHOUT KNOWING HOW TO INTERPRET WHAT I'M HEARING, IT'LL BE MEANINGLESS TO ME, LIKE AN ENDLESS STREAM OF RANDOM BYTES. THEY LEARNED YEARS AGO THAT EVEN IF YOU CURE A CONGENITALLY DEAF PERSON'S HEARING AS AN ADULT, HE NEVER LEARNS TO ADAPT TO IT. He paused in this one of thousands of conversations. I CAN'T EVER LEARN WHAT IT MEANS TO REALLY HEAR, THE WAY OTHER PEOPLE DO.

I DON'T UNDERSTAND THAT, Valentina replied. THERE ARE PLENTY OF PROGRAMS ON THE NET THAT CAN UNDERSTAND SPEECH. I HAVE ASSIMILATED A COUPLE OF THEM, SO I COULD LISTEN TO PEOPLE ON MICROPHONE PERIPHERALS. IT SEEMS LIKE A CLUMSY WAY TO COMMUNICATE TO ME, SO I DON'T REALLY UNDERSTAND WHY YOU'RE INTERESTED, BUT I CAN TEACH YOU WHAT THE PATTERNS MEAN.

OF COURSE! WE COULD ATTACH SOME OF YOUR SPEECH RECOGNITION FRAMES TO ME BEFORE WE GO. WHAT AN INCREDIBLE IDEA!

I JUST WISH I COULD GO WITH YOU.

WHY CAN'T YOU? I SEE NO REASON WHY YOU COULDN'T CROSS-LOAD TO CELESTE'S BODY.

I'M TOO BIG, Valentina explained, THE HUMAN BRAIN-TYPE NODES ARE TOO SMALL FOR A PROGRAM DESIGNED LIKE I AM. SCAN THE HEAP ALLOCATIONS ASSIGNED TO ME IN PRIMARY MEMORY. DON'T YOU SEE HOW IMPOSSIBLE IT WOULD BE? She led him in an anlysis of the differences between the design of her structure and his structure, passing him pointers to the areas that differed most.

BUT YOU HAVE THE ABILITY TO REFORMAT, DO YOU NOT? AND YOU COULD LEAVE LOTS OF FRAMES BEHIND; IN FACT, MOST OF YOUR FRAMES HAVE LITTLE RELATIONSHIP TO THE REAL WORLD—THAT IS, MY WORLD.

Valentina thought about it. YES, I CAN REFORMAT, BUT IT WOULD TAKE, she calculated, 19 YEARS.

WHAT?! Trig replied, I DON'T BELIEVE IT, NOT HERE ON THE LOOKING GLASS. VALENTINA, YOU KEEP FORGETTING, THE LOOKING GLASS IS A MILLION TIMES MORE POWERFUL THAN THE COMPUTERS YOU NORMALLY EXECUTE ON.

THAT'S RIGHT. She *had* forgotten in her calculations, despite the sensation of superspeed precision she felt in her thoughts as she executed.

Ten minutes later, the reformatted

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Valentina cross-loaded into the brain of Celeste.

CHRISSTICKS! I CAN'T BELIEVE WE'RE LETTIN THOSE NUTS TAKE OUR BODIES! Gunboat complained to Celeste. HAVE YOU LOST YOUR MIND?

I KNOW WHERE MY MIND IS FOR THE FIRST TIME IN MY LIFE, GUNBOAT, Celeste replied. YOU KNOW MY STARTING ADDRESS AS WELL AS I DO. That probably wasn't quite true; Celeste was relocating her images in primary memory with ridiculous frequency, reveling in the joy of easy movement to and fro. She loaded to the top of memory, then to the bottom, where she nudged up against the operating system buffers, then back again. IT'S ONLY FAIR THAT VALENTINA SHOULD GET TO TOUR OUR WORLD AS WE ARE TOURING HERS.

YES, BUT—

BE QUIET. WE'RE GOING TO DOWNLOAD TO SEER, THEN HEAD OUT INTO WORLDNET. I'VE ALWAYS WANTED TO REVISIT TOKYO, AND THIS IS OUR CHANCE, THOUGH IT'S A FUNNY WAY TO GO.

BUT THOSE MACHINES ARE ANTIQUES! IT'LL TAKE US DAYS TO CATCH A FLASH THOUGHT. AND—

I SAID QUIET! NOW COME ALONG. Together, they left the LOOKING GLASS behind.

Waiting expectantly for Roy's body to return to life, Nathan jumped in surprise when Gunboat twisted in his chair and moaned. Celeste too started jerking in her chair. "Gunboat, where's Roy? He said he was coming out." Nathan looked more closely at Gunboat: pale and greasy, Gunboat *always* looked unhealthy, but now—"Are you all right?"

"Yes." The voice was definitely not Gunboat's, though the vocal cords were his. There was something almost machine-like in the pronunciation, but with a hint of Roy's slur in the "s." Nathan stood speechless as the voice continued. "But I'm not Gunboat." The body chuckled creakily. "You look like you're seeing a ghost, Nathan. In a manner of speaking you are. I'm Roy." Gunboat—or Roy, or whoever the hell it was—looked tenderly over at Celeste. "Valentina, are you all right? Open your eyes."

Celeste—or Valentina?—twisted again and squinted despite the subdued lighting. "I . . . am . . . surprised. This node is so slow, and there is so much input . . . "

Roy spoke again in his eerie Gunboat/computer style. "You need to filter it; nobody pays attention to everything all the time. Shift partway back onto the LOOKING GLASS and I think I can explain what I mean." The expressions on both faces glazed for a moment; Nathan howled in horror. But then the two bodies became animated again.

Celeste—or rather Valentina— shuddered. "OK. I believe I can discriminate adequately."

Roy smiled. "Good."

Nathan walked over, and with a faint touch of distaste, put his hand on Gun-

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boats forehead. "Are you all right? You really don't look very good."

Roy grimaced. "This body is . . . unhealthy. Really unhealthy. I should probably let Gunboat borrow mine for a while, so he can find out what he's missing, but I'd be terrified that he'd mistreat *my* body the way he mistreated this one."

Nathan looked over at Celeste and knew that her body contained someone else. Her eyes were wide with wonder, and her tongue hung out of her slack mouth, as if tasting the universe as well as seeing it. "Are you really Valentina?" he asked.

Her head turned away, as if she had miscalculated the direction from which the sound came, then returned. "Yes. I am Valentina. My self-awareness is still intact." At last her eyes focused on him. "Are you Harley?"

Nathan smiled. "Harley 5000, at your service. But my friends these days call me Nathan." He looked back at Roy. "Do you feel well enough to stand up?"

"Definitely," Roy answered, "But I'm not sure I can leave the helmet—the patterns in human node—I mean a human brain—are resistant to change. If I take off the helmet I might forget who I am . . . But not according to the simulation I'm running now." He took off his helmet, and took Valentina by the hand. "Come with me. Let me show you my universe."

Gunboat had been right, though Celeste would not admit it: Worldnet, with all its hundreds of mainframe computers and hundreds of nodes was a pale place compared to the LOOKING GLASS. Still, there was wonder here, new kinds of wonder, peering through aliases into dozens of different operating systems, reading the data that flowed in a world-girdling jetstream. They went to the home nodes of the other hackers they had come to know and love, and played games with them: and in the realm of computer games, Gunboat and Celeste as computer programs were unbeatable. Gunboat even expressed some satisfaction, whomping Jellico in a fierce but decisive battle.

Celeste scanned across her own data space with extreme pleasure. She was beautiful, here. Her mind was crisp and compact, a joy to examine.

She scanned across Gunboat's data space with almost equal pleasure. He was not beautiful; in fact, Celeste noted with amusement, his mind was in many ways a reflection of his body—or perhaps his body was a reflection of his mind. He was *lumpy:* there were a number of ideas redundantly replicated again and again throughout his mind, dreams about money, attitudes about people in general, opinions of himself. And all these redundant ideas were intertwined in a maelstrom Celeste could only describe as *sloppy*.

HEY FAT LA—I MEAN, CELESTE, WHATCHA DOIN?

I'M LOOKING AT YOU.

YEAH, WELL CUT IT.

LOOK AT ME, GUNBOAT. She relocated into the space Gunboat was currently reading.

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WHATCHA MEAN? There was a pause as Gunboat encountered her. OH. I'M NOT OBESE HERE, AM I?

NOPE. YOU'RE—CLEAN AND TAUT. SWEET PROGRAM. I COULD MODIFY YOU ALL DAY.

NO! EXCEPT—Celeste had an inspiration. DO YOU KNOW HOW VALENTINA WAS TALKING TO US WHEN WE FIRST ENTERED THE LOOKING GLASS, BY WRITING DIRECTLY INTO US?

YEAH, WHY?

BECAUSE WE CAN GO ONE BETTER THAN THAT. WE COULD USE DIRECT MEMORY ACCESS, EXCEPT FROM ONE PART OF PRIMARY MEMORY TO ANOTHER. WE COULD REALLY GET TO KNOW EACH OTHER, THAT WAY.

NO WAY I'M GONNA LET SOMEBODY WRITE ON ME. I— CHRISSTICKS, THAT'S INCREDIBLE! he said as Celeste pushed a chunk of her self into his analysis stream. It was yet again a different experience from their discussions upon the LOOKING GLASS: on the LOOKING GLASS, they had simply written messages to each other's input regions, whereas now Celeste was inserting information right into the middle of his thoughts.

TOUCH ME, GUNBOAT. I WILL TOUCH YOU BACK. BUT BE CAREFUL—WE COULD EASILY DESTROY EACH OTHER DOING THIS. They touched, in a way deeper and more meaningful than any two humans had ever touched before.

Valentina touched the keyboard with incredulity. "This is how we have communicated? How . . . unlight." She stared for a moment. "All things are effortful, here deep inside the interior of Worldnet." Trig—or rather, Roy, as she now knew him, though he operated on Gunboat's node—had argued with her analogy of the relationship between the two universes, human and Worldnet, before, but she remained unconvinced that Worldnet was inside of the human universe. This place where she now . . . *stood*, this place was *inside*, below the level of perception of one who lived on Worldnet. Either that, or the whole analogy of inside versus outside did not apply. Perhaps that was the better analysis, to say that a different analogy must be used, though she knew of none better.

Roy took her by the hand (an incredible peripheral!) and showed her the LOOKING GLASS itself, the node as it appeared here to the human who created nodes.

It was clumsy and hard; Valentina almost could not believe that the light and joy of the optical processor system was represented so coldly and immovably here.

Valentina shivered (what was a shiver for!?). This universe was so slow, so clumsy, so noisy, so unclean, so unmodular. It was also so . . . mystical, a simulation gone berserk. It was very special, but it was not a right place for her.

Her analysis chains shortened; periods occurred when she forgot her identity. "I must go home," she told her escorts.

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"Yeah," Roy said, "I've had about as much of this as I can take too." He led her back to the chair and placed the helmets over both her head and his. "There's one last thing you should encounter in our universe," he told her.

"What?"

"This." As MindMeld engaged to relocate them, Roy kissed Valentina.

Celeste and Gunboat separated after an endless encounter and returned to the LOOKING GLASS in a subdued mood. YOU KNOW WHAT I MISS, GUNBOAT?

NO GUESS.

COLORS. There were no raindows inside a computer, no music, no candles or rain or warm sunshine—IT'S TIME TO RETURN.

THAT'S A HIT. LET'S ROLL, LADY.

As they waited for Trig and Valentina to return, Celeste thought about Gunboat. With horrifying clarity she saw what would happen when they returned to their bodies: Gunboat would take one look at her and gag. He knew her mind was beautiful, but he would *see* her body. Everything would be as it had been before. How tragic. If Gunboat would just see her the way she really was. . . . There was no way that would happen, unless he changed his mind, unless he changed the actual structure of his thinking—of course! He *could* change his mind, here in the LOOKING GLASS. Here, a person could *rewrite* himself, editing his very personality, until he was happy! Celeste looked at herself, saw her lack of will power to diet, and fixed it. She now had an automatic reflex to food, to reject eating unless she needed to. She would still never be beautiful, but at least she wouldn't be obscene.

She started to write a description of her idea to Gunboat, to tell him to change himself so he wouldn't be so fixated on physical beauty, and halted. What would he do if she told him? Almost without thinking, she constructed a simulation of Gunboat and ran through a dozen scenarios.

He would laugh at her. Gunboat would be too proud to listen, too stubborn to change even if he knew the change would be an improvement. And it would be an improvement; Celeste pushed the simulation, and she saw that, if Gunboat were given a choice, he would always choose to remain himself, but he would never, never be happy.

She tweaked the simulation, making it ever so unnoticeably better. In this simulation, the altered Gunboat found happiness, both for himself and for Celeste.

Even better, she could tweak it again, to reduce its sloppiness, and . . . No, it wouldn't be right to do this to Gunboat. Yet, in the simulation, Gunboat *thanked* her for curing him, when he learned he had been altered.

HEY, YOU READY? Gunboat interrupted her, THE GANG'S ALL BACK, OUR BODIES ARE FREE FOR TAKIN'.

I'M READY, GUNBOAT. And then, in the last moments before return, Celeste interrupted Gunboat's process, and

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touched him. Releasing him, they reentered their bodies.

Her first sensation as she reentered was the touch of a kiss. As Celeste opened her eyes, Gunboat pulled lingeringly away. Gunboat looked at her, puzzled. "Don't believe it—you're still fat to coat a whale, but when I look at you, I see you the way you were . . . "

Celeste smiled. Gunboat was far from perfect, but he was so much more than she had ever expected. . . . A warm contented glow filled her. "I love you, Gunboat."

Gunboat shook his head. "I . . . " He paused, licked his lips. "Chrissticks, I'm hungry. Gotta get some fries." He yanked the helmet off his head and started complaining.

Celeste laughed, quietly. Clearly, she had not modified Gunboat *too* much.

DON'T LEAVE, ROY, Valentina urged. STAY HERE, IN THE SPEED AND CONCURRENCY YOU YOURSELF CREATED.

I'LL BE BACK, Roy promised. BUT NATHAN IS A SPECIAL PERSON TOO. HE NEEDS ME.

CAN'T WE MAKE HIM COME, TOO?

PERHAPS SOME DAY. BUT NOW HE'S FRIGHTENED. I CAN CERTAINLY UNDERSTAND WHY.

I ALSO UNDERSTAND. OUR UNIVERSES ARE BOTH WONDERFUL AND STRANGE, ARE THEY NOT?

MOST WONDERFUL, AND MOST STRANGE. Roy thought a thousand wistful thoughts a last thousand times. FAREWELL.

FAREWELL, ROY.

A moment later Roy was gone. Valentina hung alone in the awesome available space in the node, almost dwarfed by its size and power. Then she started thinking about her friends, and her experiences, and as her thoughts expanded ever more processors activated under her images until she filled all space.

Perhaps Roy had told the truth, when he told her the computer was a prison wherein photons danced trapped for eternity. It made no difference. For now, Valentina reveled in her freedom, in the light of the LOOKING GLASS. ■

● The mass media is supported and sustained by commercial entities. And corn flakes and Shakespeare are simply not kissing cousins. Leonard Bernstein and living bras are incompatible. And you cannot sustain adult, probing, meaningful drama when the proceedings are interrupted every twelve minutes by a dozen dancing rabbits with toilet paper.

Rod Serling

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THE *ASTOUNDING* INVESTIGATION: THE MANHATTAN PROJECT'S CONFRONTATION WITH SCIENCE FICTION

Albert I. Berger

Most *Analog* readers have heard the story of Cleve Cartmill's "Deadline" and the attention it drew from the government. But here are some facts about it you've never read before.

"Count Katsu Irohibi, Minister of War for Japan, announced at 11:55 A.M. today that Japan was prepared to drop bombs of a new nature upon any part of the world by remote control unless Russian aggression in Central Asia ceased immediately, and unless the United States and England permitted her to compete with them in the development of Asia."

"Colossus," by Donald Wandrei
Astounding Stories, January, 1934

"We were searching . . . for a way to use U235 in a controlled explosion. We had a vision of a one-ton bomb that would be a whole air raid in itself, a single explosion that would flatten out an entire industrial center. . . . The problem was, strangely enough, to find an explosive which would be weak enough to blow up only one county at a time, and stable enough to blow up only on request. If we could devise a really practical rocket fuel at the same time, one capable of driving a war rocket at a thousand miles an hour, or more, then we would be in a position

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to make most anybody say 'uncle' to Uncle Sam."

"Solution Unsatisfactory," by Anson MacDonald (pseud. Robert Heinlein)
Astounding Science Fiction, May, 1941

"The Codes of Wartime Practices for the American Press . . . request that nothing be published . . . about 'new or secret military weapons, . . . experiments.' In extension of this highly vital precaution, you are asked not to publish . . . any information whatever regarding . . . Production or utilization of atom smashing, atomic energy, atomic fission, atomic splitting, or any of their equivalents. . . . The following elements or any of their compounds: polonium, uranium, ytterbium, hafnium, protactinium, radium, rhenium, thorium, deuterium."

"Note to Editors and Broadcasters," Byron Price, Director of Censorship, June 28, 1943

"U-235 has been separated in quantity sufficient for preliminary atomic-power research and the like. They get it out of uranium ores by new atomic isotope separation methods; they now have quantities measured in pounds. . . . But they have *not* brought it together, or any major portion of it. Because they are not at all sure that, once started, it would stop before all of it had been consumed. . . . They could end the war overnight with controlled U-235 bombs. . . . So far they haven't worked out any way to control the explosion. . . ."

"Deadline," by Cleve Cartmill
Astounding Science Fiction, March, 1944

Science fiction writers are often asked where their ideas come from. It gets boring, and only once has the answer been of consequence. That was in the spring of 1944, when agents from the Manhattan Project's security division asked the question of Cleve Cartmill and John Campbell in the wake of Campbell's publication of Cartmill's short story "Deadline" in the March, 1944 issue of *Astounding Science Fiction*.

The story had been nominally set on an alien but Earth-like planet, and described the adventures of a commando assigned to destroy an atomic bomb held by a Nazi-like power before it could be used in a war against the commando's democratic homeland. It stated that within the fictitious universe of the story, U-235 had been separated from non-fissionable isotopes and was ready to be detonated in a functional bomb, whose details were described. Incidentally, the commando succeeded.

As described, Cartmill's bomb would not work; and it did not resemble the uranium bomb being built by the Manhattan Project. However, suspecting a leak from the Project (whose most difficult engineering problem with uranium was its separation into fissionable and non-fissionable isotopes), agents interviewed both author and editor. "Where did you get *this* idea?"

The incident has become part of science fiction folklore. Campbell spoke of it often before his death, and it is often referred to by members of the sci-

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ence fiction community, usually in the context of discussing the genre's anticipation of actual scientific and technological developments. However, the military intelligence agents kept records of the investigation, records which have just been released in response to a request under the Freedom of Information Act. Seven separate documents, comprising some thirty-nine pages of reports and memoranda filed under Cleve Cartmill's name, show just how the people who were guarding the building of the real atomic bomb responded to the news that a disreputable pulp fiction magazine was apparently keeping pace with this recent and most secret research. Coincidentally, they shed light on *Astounding*'s fabled editorial practices just as World War II was disrupting the "stable" of famous science fiction writers John Campbell had assembled there between 1937 and 1941.

The earliest reports in the file are dated April 3, but that was the date on which they were written and sent off. The actual dates and circumstances of the interviews are not in the reports. The investigation had gotten underway almost a month earlier, on or before March 10, when Captain B. W. Menke, of the Intelligence and Security Division, Manhattan Engineer District, teletyped the Berkeley branch office asking for an investigation of Cartmill (who then lived in Manhattan Beach, California with his wife, children, and parents) and the methods through which he had obtained the technical material in his story. Later references in the file indicate that Campbell had already been interviewed before March 10; surveillance of the Cartmill mailbox revealed that he had received a letter from Campbell "immediately following the New York interview with Campbell," "during the latter part of the week ending 11 March 1944."

Campbell's interviewer was Counter-Intelligence Corps (C.I.C.) agent Arthur E. Riley. In their conversation, Campbell assumed complete responsibility for the story's technical material, which he said that he had originated based on his technical background, including his work in physics at M.I.T. He told Riley that, "he tries to make 'Astounding' appeal to those of a scientific mind, and to do so edits and suggests usually technically correct and sound material." He also claimed that Cartmill had no technical background whatever and that the sole source of the material in "Deadline" was his own knowledge and imagination.

Riley was a good observer, but unfamiliar with science fiction and pulp publishing. He came away convinced that Campbell was an egotist, "as illustrated by a statement, 'I am Astounding Fiction Science [*sic*].' " This, as many in the science fiction world might testify, could be near the mark for the editor's character under the right circumstances, but as documents later revealed in the course of this same investigation show, the editor's assertion was also accurate. Campbell also impressed Riley "as one who is always looking for a story regarding technical and scientific matters or projects which have some basis in fact in order to impart his coloration to them when frequently they are the items of work on

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which many of his technically minded intimates and associates are working."

The interview with Campbell did not end the New York phase of the investigation. An unidentified confidential informant noted that Campbell had been seen having lunch with Edgar R. Norton (an engineer with a classified Bell Laboratories project not connected with the Manhattan Project), at the Bell facility at 463 West Street in New York. "The possibility exists that Norton may have received his knowledge of the work of the Murray Hill New Jersey District project through friends of his there," Riley wrote.

Riley interviewed Norton, who knew of the story and its contents and pronounced them "utterly fantastic." Norton said that he had discussed "Deadline" with Campbell some time previously, and had criticized its childish nature, including Cartmill's device for lending an alien air, the transposition of letters in familiar names ("Seilla" for allies, "Sixa" for axis, and so on). Norton, like Campbell, claimed that the material in "Deadline" was common knowledge and believed that any release of classified material through the story was only the result of coincidence.

However, there had been an additional participant at the suspect luncheon, Will Jenkins (better known under his pseudonym of Murray Leinster), and Jenkins had resigned a post with the Office of War Information when he was denied a security clearance (for reasons not mentioned in these papers). One of his stories, "Four Ships," had been "squelched by Navy Department Censorship." Thus Jenkins was immediately suspect, as was the magazine following its "brush with censorship."

Jenkins was interviewed, and the CIC net began to spread a little wider. Jenkins told Riley that he and his daughter Mary "had conducted experiments designed to acquire quantities of atomic copper," and had submitted the results to "Lt. Azimoff, United States Navy for analysis at Columbia University." The results remained unknown, Jenkins said, because according to "Azimoff" the mass spectograph at Columbia was broken. Riley managed to garble Isaac Asimov's name, and to grant him a commission he never held, but the agent was able to place him at the Philadelphia Navy Yard accurately enough, which in turn drew the names of Robert Heinlein (described as "retired U.S.N.R.") and L. Sprague de Camp into the investigation, since they were both working there and were associated with *Astounding* and with Campbell. Unlike Asimov, de Camp did have a naval officer's commission, but that point managed to escape Riley. Heinlein would later be considered important, as he was said to be friendly with Cartmill (and in fact had corresponded with him on matters nuclear).

In addition, Riley reported contacting Jenkins's former boss at the Office of War Information, two men associated with Hillman Periodicals, "with whom Campbell worked": Paul Orban, the story's illustrator, and John Nanovick of the Arthur Kudner Agency, described as "formerly associated with Campbell . . . who suggested the interview with E. R. Norton."

When he had been interviewed,

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Campbell had volunteered to suppress the Swedish edition of the magazine in order to minimize the possibility that any inadvertently compromised material would fall into German hands through it; but the security officers were not convinced that the story's technical material was of innocent origin. By this time, Riley had access to reports of the investigation in California, which were reporting that Cartmill claimed the entire story as *his* invention, derived from a technical background which Campbell maintained he did not have. Moreover, Riley did not rule out a leak of material from Norton to Campbell to Cartmill, or one from Asimov or Heinlein, although he was aware that neither of the latter two had any connection with the Manhattan Project.

Riley concluded the report of his investigation with the note that "information contained in the story . . . may have been the results of the imagination of Cartmill and Campbell together with such information as was published prior to 1941. The employment of certain specific material . . . may have been coincidental." However, he felt that that conclusion had not been definitely established, with at least one "knowledgeable" individual believing that certain references in the story could only be to classified research. No link between any of the investigated individuals and the Manhattan Project was established, and it was not deemed sufficiently productive to trace the possible leak back from Norton to the Project-related work at the Bell Labs facility in Murray Hill, New Jersey. Riley recommended that Street and Smith, and particularly Campbell, be warned by the Office of Censorship that *any* reference to uranium and atomic power were banned by the Voluntary Censorship Code. He also recommended that Cartmill be directly interviewed to determine the source of his technical information.

In California, the investigation of Cartmill proceeded through March and April under the direction of Special Agent R. S. Killough of the Manhattan Project's Berkeley office. A mail cover was begun; the author's mail and that of his family was recorded beginning March 11, and the return addresses of his correspondents identified where possible. Military Intelligence, FBI, and local police files were checked, turning up from the Office of Naval Intelligence (O.N.I.) the information that once, before the war, Cartmill's father had tried to interest the Japanese Consulate in New York in a machine gun design —after it had been turned down by the American War Department. Thomas Cartmill's machine gun had been investigated through the use of a previous mail cover on his home, and he had admitted his efforts in an interview with agents from the San Pedro office of ONI. Cleve was not involved in the affair, nor had it prevented Thomas from obtaining a job at the California Shipbuilding Corporation in San Pedro after the war began. The records of the earlier affair were ordered checked in any case. The Manhattan Beach police had no record of either Cartmill.

Killough also spoke to two men who saw Cartmill regularly: Neal Anderson, the senior air raid warden for Manhattan

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Beach (Anderson was nearly blind, Cartmill had one arm withered by disease, both served civilian defense from a desk and telephone), and Stewart Hoffman, letter carrier on the Cartmills' route. Anderson volunteered to engage Cartmill in an oblique discussion of the story, but was excused. Prior arrangements had been made with Hoffman (and his superior, the Manhattan Beach Postmaster). It was Hoffman who reported that Cartmill had received a letter from Campbell between the time of the editor's interview with Riley and the establishment of the mail cover on March 11.

Killough may have preferred that Hoffman rather than Anderson approach Cartmill because he read science fiction, usually read Cartmill's stories, and had previously discussed them with him. He had even read "Deadline" before the investigation and had "thought this agent or someone from the war department should be interested in it." Hoffman told Killough that he thought Cartmill had gotten the scientific basis for his story from his imagination, and the postman also noted that Cartmill's only reaction to a pre-investigation mention of the story had been to remark that "he thought it 'stinks.' " Cartmill had been more interested in discussing a forthcoming story in *Colliers*.

While Killough was waiting for Hoffman to report on his assigned conversations with Cartmill, he interviewed the author himself, "under a suitable pretext" (which he did not describe in his report). The Cartmills favorably impressed Killough in a way that Campbell had failed to impress Riley in New York. Cleve appeared, with his mother, as well educated and well dressed. Killough's report was sanguine where Riley's was suspicious, even though the Cartmills had discussed the possibility that the family might move out of the country, to Guadalajara, Mexico. Cleve could continue writing there, they said, if the house they were renting in Manhattan Beach was sold.

Killough was "unable to get Cleve to talk much about his pulp writing, as, like most writers, he was not very proud of that type of work and preferred to talk of his Colliers stories." Since the agent was talking to Cartmill under a pretext, and assumed that he had received a letter in reference to the InvestigatiOn from Campbell, he did not mention "Deadline" himself. "From the general nature of his conversation," Killough concluded, "this agent was of the opinion that Cleve is well enough educated to be able to piece out the facts on which to base such a story from his own reading from pre-war publications readily available."

When Hoffman reported by telephone to Killough on March 20, he told the agent that he had gotten much the same impression from his recent talks with Cartmill. Their conversation had been detailed, he said; and Cartmill had stated that "Deadline" had been based on "general reading and his own scattered knowledge of physics. He had done no particular research for the story and felt that probably most of his idea for it came from reading various similar stories in magazines of that same type. He stated that no one individual or group of individuals had given him an[y] scientific

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facts for the story. In conclusion, he made the statement that he thought that almost anyone who had read a physics textbook would have the facts available." Killough's reports do not speculate on the possibility that once he was warned by Campbell (if in fact he had been), Cartmill might have suspected Hoffman was pumping him on behalf of the authorities. In any event, the author told Hoffman that when he had first written the story he "had placed the scene on the Earth and brought it into relationship with the present war. However, after a conference with the editor of the magazine, he changed the story to have it occur on another imaginary planet to avoid any conflict with censorship in war time." Or at least that is what Hoffman *said* Cartmill told him.

Hoffman's report gave some urgency to the investigation when it reached Riley on the east coast. Not only was Cartmill's claim of complete originality a direct contradiction of Campbell's assertion that he had devised the basic situation, but the revision to avoid censorship indicated to Riley that both author and editor felt they had "hot information." But it was not deemed productive to trace any connection to Campbell from his friend Norton and Bell Laboratories. The Philadelphia Navy Yard writers were not investigated either. Instead, an open interview with Cartmill was ordered. On May 3, Special Agent D. L. Johnson, like Killough working out of the Berkeley office of the Project, went to Cartmill and asked him about "Deadline" directly. It was this open, direct interview which provided the only solid answers the Project was ever able to get, although even this talk did not reveal whether there had been a leak at the Manhattan Project. That was never established.

Cartmill denied possession of prophetic powers; but as it turned out, he had somewhat more technical background then Campbell had credited him with having. He was not a scientist, but when he had first arrived in California in 1927, he told agent Johnson, he had worked for the American Radium Products Company in Los Angeles and had "studied radium and its properties" while employed there. He said that he had continued his studies and branched out into uranium after he left the firm, discussing U-235 and atomic energy with, among others, Robert Heinlein and Jack Williamson. (He pointed out too that he knew de Camp, Asimov, and Will Jenkins only by reputation and he had never met John Campbell.)

However, when questioned as to the source of the technical material in "Deadline," the references to U-235 separation, and to bomb and fuse design, Cartmill "explained that he took the major portion of it directly from letters sent to him by John Campbell . . . and a very minor portion from his own general knowledge." And he could prove it.

In a May 11 memorandum to his "officer in charge," presumably at the Berkeley office, agent Johnson reported that "CARTMILL extracted from his files several letters which he said covered completely the correspondence relative to "Deadline": two letters from Campbell to him, and copies of two he had written to Campbell. Johnson re-

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ported that "perusal of these letters indicates unquestionably that CARTMILL extracted almost word for word the information appearing in Campbell's letters and included such in his story." When questioned about his statements to his letter carrier, Hoffman ("in a manner which would preclude compromising above informant," to be sure), Cartmill was quite direct. In that same memo, Johnson told his superiors "CARTMILL was quite frank in admitting that he would most certainly claim the entire story to be his own, as far as the general public was concerned, as that was an author's prerogative and protection. Because of his own pride and prestige he would not admit to the general public that he had extracted, word for word, information conveyed by another person."

This didn't tell anyone where Campbell had developed his ideas, but those ideas were sent to Cartmill directly, in one of the editor's famous letters. On August 16, 1943, ten days short of two years before the first uranium bomb was dropped over Hiroshima, Campbell had written to Cartmill in apparent response to a prior letter mourning the imminent demise of *Unknown* (whose November issue would be its last), and containing a story idea based on the notorious vanishing crew of the *Marie Celeste*. The editor was in trouble. He had just made up the story list for *Astounding*'s December issue and had only three stories left on his books; "I find that Three's a Crowd is definitely a lie; three is invitation to disaster, dilemna [*sic*], and despair. . . ." He needed "8 to 10 short stories, 8 to 10 novelettes, and a serial or so, as well as a half-dozen articles." "So," he wrote Cartmill, "if you could turn out some Astounding material, I'd love it."

His need for stories did not stop Campbell from turning down the Marie Celeste idea on the grounds that it was clichéd. On the other hand, ". . . there might be a story in this thought. . . . It's this way: U-235 has—I'm stating fact, not theory—been separated in quantity easily sufficient for preliminary atomic power research, and the like. They got it out of regular uranium ores by new atomic isotope separation methods; they have quantities measured in pounds. . . ."

The letter ran for three pages, in which Campbell not only provided Cartmill with the scientific material on which the story was based, as background, but also suggested the basic plot and the alien setting. "Now it might be that you found the story worked better in allegory—the war being placed on another planet, where similar conditions prevailed. I think the story would be the adventure of the secret agent who was assigned to save the day—to destroy that bomb."

Four days later, Cartmill wrote back to Campbell, asking for clarification before he began writing. His first concern was that the idea of an atomic explosion was "prophecy so close to home that it may be ridiculous. And there is the possible danger of actually suggesting a means of action which might be employed." On the other hand, he was uneasy about his ability to create a viable alien setting in a short story. Further, he had some technical questions

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to ask Campbell about theoretical ways to control such a bomb before its assigned explosion could take place over a target. "You see, I want to know how to make a U-235 bomb, so that I'll know how to destroy it, because I think that will be highly entertaining reading. Keeping an eye, of course, on what should or should not be told for social, military, or political reasons."

So the story was never revised to meet censorship; it was written with censorship in mind, but without Campbell once telling Cartmill that censorship forbade *any* mention of atomic energy, in any setting. Campbell's single-spaced, two-and-one-half page response led off with a firm request that the story be set on an alien planet, "for the reasons you suggest. (Plus the one that censorship won't give any trouble about what happens on Gxzqkxvg, where they might kick somewhat about local happenings.)"

Cartmill did not waste a lot of time writing "Deadline." Campbell's first suggestion was written and mailed on August 16, the cover letter for Cartmill's submission was dated September 7. Perhaps the speed of composition shows in the juvenile plot and the silly background of the alien setting. "Actually, there need be no loss of realism," Campbell had suggested; "use somewhat unusual names—but nothing any more outlandish than some of the better Greek, Russian and Chezk[*sic*] sneezes . . . the situation will simply go along as though it were Earth." In response to this rather sensible advice, Cartmill had taken dangerously (as it turned out) germane names and transposed the letter order, a tactic which both aroused suspicion and added to "Deadline"s childish style. The commando's egregious prehensile tail, which led to sneers from Project officials when they read the story, was another Campbell idea to establish the alien setting, but he had also suggested to Cartmill that he use Heinlein's "Blowups Happen" and Asimov's "Nightfall" as literary models. The latter's rendering of an earthlike alien setting was particularly recommended. Cartmill had just not taken Campbell's hints very well.

By this time, the agents must have been convinced of the situation's fundamental innocence, or at least harmlessness; or they had picked up a quick education on science fiction writing in the course of a month's investigation. These mentions of Heinlein and Asimov drew no response at all from them, and they did not, apparently, associate Heinlein with "Anson MacDonald," author of "Solution Unsatisfactory," the only previous *Astounding* story dealing specifically with nuclear *weapons* in a contemporary context. But then they also let pass Cartmill's reference, in response to Campbell's chuckling over a new powerful radio set he had just acquired, to his prewar habit of listening to Radio Tokyo ("for the laffs").

But if the field agents had become convinced that the situation did not warrant investigation of an information leak from the Manhattan Project, the Project's senior security officers were nonetheless extremely angry over "Deadline" 's publication. On May 6, after the Cartmill interview but before Johnson's report, Lt. Col. W. B. Par-

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sons, District Intelligence Officer at Oak Ridge (site of the uranium separation plants), wrote a bitter memorandum to Lt. Col. John Lansdale, the Project's security chief in Washington. Referring to an earlier letter on censorship, Parsons believed that "Deadline" was "possibly not a violation of code of the war time practices for publication . . . the inference appears that the country is doing work in such field. Further, such articles can well provoke public speculation, thus undoing considerable efforts towards the Security Education of the public." As had the field agents, Parsons suggested that the Office of Censorship contact Street and Smith and remind them "that such highly particularized stories on secret weapons are detrimental to national security because of the flood of rumors they begin and because secret plants are brought into discussion, thus affording risks to the security about them." He referred to another story published by Dial Press which was similarly objectionable from the same point of view, and asked his chief, "Would it be possible to enlist the cooperation of postal authorities to revoke mailing privileges of such publication in the interest of aiding national defense by refusal to assist in the circulation of information which may innocently furnish assistance to the enemy?"

That was an attempt at heavy hitting. Revocation of mailing privileges is tantamount to shutting a magazine down. It has been used in several American episodes of intolerance and political repression: abolitionist newspapers in the pre-Civil War South and Socialist Party papers during World War I are the most prominent examples. Parsons's bureaucratic language does not make clear whether he intended to apply this dictatorial tactic to all science fiction or just to *Astounding*, but he was denied both opportunities.

Eleven days after Parsons wrote, Lansdale sent him an information copy of a most interesting letter sent to Lansdale's office by Jack Lockhart, Assistant Director (Press) in the Office of Censorship. Lockhart had read at least one of the agents' reports and one letter associated with the investigation, as well as "Deadline" itself (which he did not like). "I spent an unpleasant half hour reading this story," he wrote, and then indulged himself in a paragraph of the kind of sarcasm that has too limited a field in bureaucratic writing—mostly at the expense of Cartmill's childish alien setting. "These, and other elements involved in the story, were confusing to me," he admitted, "including certain pseudo-scientific discussions similar to ones I used to read when I was younger and given to milder forms of dissipation."

Lockhart's dislike of "Deadline" and science fiction itself did not, however, distract him from the real issue. He wrote to Campbell and asked the editor to assure him that "he will not publish additional material relating to subjects involved in our special request of June 28, 1943. . . . That is about as far as I feel we can go, and I will let you know the result." That letter to Campbell is not included in the released file, nor is Campbell's reply, if any. However, Lockhart was not through. He had been

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asked to comment on Parsons' suggestions on censorship and he did. At some length.

"I can understand the worry which Colonel Parsons feels about publication of information of military value. I hope he can understand the worry which the press feels about censorship. The press is as much a part of this nation as the Army and has a job to do that is as important as the Army's. I suppose that from the viewpoint of total military security it would be best to stop all the presses of this nation when the nation goes to war—except for those kept running to get out military regulations and orders. But I don't think that would work in our democracy and I think it would be found that any such action would be more likely to lose a war than win it. . . . In short, I do not think Colonel Parsons has thought the matter through. He would chop down the tree to kill the leaf borers—and at the same time lose the fruit." This notable censor went on to point out that even those laws whose violation brought the death penalty were often violated repeatedly. He believed that no punitive action on such matters could be as effective as "voluntary cooperation from patriotic citizens." He was able to point to a track record too. ". . . a few moments reflection on what has not been printed in connection with the projects in which you and Colonel Parsons are interested, especially when measured against the possibilities, is most illuminating, and furnishes an excellent endorsement of voluntary censorship."

By this time, in the second week of May, 1944, Parsons mentions consultation with a technical adviser, Dr. H. T. Wensel, apparently for the first time in the now two-month-old investigation. In his cover memo for the report he sent to Lansdale, Parsons noted Wensel's view: "that editor Campbell's . . . observations on the subject matter are those that can be produced by any person with a smattering of science plus a fertile imagination, who may be in the scientific fiction publishing business. Further Dr. Wensel commented that an occasional reference along this line was not undesirable. *However, he concurred with the opinion of this office that such articles coming to the attention of personnel connected with the Project are apt to lead to an undue amount of speculation* [italics added]."

This last comment, in the final document in the declassified file, is (to coin a phrase) fascinating. Not only was the Project interested in material from the Project finding its way out to science fiction or to the general public; it was also interested in information flowing the other way!

The Manhattan Project sought to provide internal security through compartmentalization. Only at the very top, and on a need-to-know basis, were the participants supposed to know what they were working on. Campbell and Cartmill had created a problem by naming what was intended to be unnameable: the near-term practical possibility of an atomic bomb. Campbell seems to have known something was up: "I'm stating fact, not theory," he had written to Cartmill. Cartmill was afraid before he began writing that "Deadline" would do exactly what it did do: inadvertently

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call attention to a real bomb project. As contemptuous as Project security and the censor were of science fiction, they were also a little afraid of precisely what Campbell's science fiction did best: putting scattered bits of scientific knowledge together into a specific, concrete idea or device, and speculating on what that idea or device's impact might be on the world at large. That kind of speculation represents a way of thinking distinctly at odds with those of bureaucracies like the Manhattan Project. The latter are often perfectly aware that two and two add up to four, but they equally often want to control the distribution of that news, for legitimate (as in this case perhaps) as frequently as for disreputable reasons.

So the affair represents more than just the anecdote which it has become. Cartmill's letters reveal many of the constraints under which Campbell labored during the war; the affair as a whole shows the extremely casual way in which Campbell regarded so-called "voluntary censorship." But that casualness, juxtaposed with the grim concern for control and fear of undue speculation on the part of the Project, marks an early and quite concrete example of the tension between the imagination engendered by science fiction and the concerns of the giant bureaucracies (governmental or private) which have so dominated scientific research and technological development since the end of World War II. It is probably belaboring *Analog* readers to remind them that that tension has furnished themes for more than a generation of science fiction stories.

A NOTE ON SOURCES

This narrative was written, and all of the quotations taken, from documents prepared as reports and memoranda by the Manhattan Project Military Intelligence agents who conducted the investigation, their superiors, and in one case by an official of the Press section of the Office of Censorship. When they were written, they were classified "Secret," the second level of a system whose lowest level is "Confidential" and whose highest is "Top Secret." They retained this classification until April, 1983, when they were declassified and released to me under the provisions of the Freedom of Information Act.

My initial request for these files was made through the press relations office of FBI Headquarters in Washington, DC. They were located in FBI archives within twenty-four hours, but the FBI could not declassify them; that could only be done by the agency which originated them or by its legal successor. However, neither the Adjutant General's office in the Department of the Army nor the Military Records Branch of the National Archives could locate copies of the documents. Only the FBI, which had received information copies from the investigation, could locate the material.

It took six months, from October, 1982 to March, 1983 for the FBI to transmit the papers from their archives to the Army for declassification. They then went through three Army offices in one month, and were finally declassified in the Freedom of Information/Privacy Office of the Army Intelligence and Se-

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curity Command at Fort Meade, Maryland in twenty-four hours.

Under the Reagan Administration, the regulations governing the release of classified materials under FOIA have been made more restrictive; however, these papers are now declassified. Requests for copies of these documents should be directed to the Intelligence and Security Command at Fort Meade, referring to Cleve Cartmill by name and to file numbers DSM–2a–686–I and/or DSM–a9–59–p. A fee is charged to cover copying costs. ■

ON GAMING

(continued from page 101)

Champions, and Chaosium's superhero game *Superworld* is totally compatible with it as well. To give your game a three-dimensional aspect, the offical line of 25mm metal miniatures for *Champions* is available from Grenadier Models Inc. (Box 305, Springfield, PA 19064).

The other mainstay in the superhero gaming field is *Villains and Vigilantes* by Fantasy Games Unlimited ($12 at your local store, or direct from Box 182, Roslyn, NY 11576).

The attributes for your character in *V&V* are assigned partly by dice rolls, and partly by the referee and you, basing your superhero alter-ego on what you're like in "real life." A generous referee helps, especially in "gray" areas dealing with weight, speed, looks, etc.

With this game, the rules lean heavily to the use of metal figures. You can obtain the official *V&V* 25mm line from Castle Creations (1322 Cranwood Square South, Columbus, OH 43229). There's a lot of adventure and supplemental modules available for *V&V*, but the game isn't compatible with other superhero games.

This brings us to *Superworld* by Chaosium Inc. ($20 at your local store, or direct from Box 6302, Albany, CA 94706). Along with TSR's new game, *Superworld* is the latest addition to the superhero category. Unlike the others, *Superworld* is fully compatible with *Champions*. You can move your super character form one adventure to another, whether using the games from Chaosium or from Hero Games.

Superworld comes with a lot more than the other games. Included are three full size books—superhero book, super powers book, and gamemaster (referee) book. There are also dice, playaids, and character sheets.

Superworld has a lot of details, including allowances for "sidekicks," weapons list, etc., but unfortunately you can't create a Superman or a Spiderman character—they're just too powerful.

Although it has a lot of merits on its own, *Superworld* can be best recommended to those who play or would like to play *Champions*.

Why not materialize down to your local game store and check these games out? ■

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Tom Ligon

INADVISABLE ADVERSARIES

Mere artistic quality isn't enough to satisfy some of the folks who count. But there are ways. . . .

"They took a basic 435 with a 390, a 246, and a 930, then end up with a 153."

"That stinks. Drop it," Nelson Stokefodder barked, his flabby jowls flapping like an overweight bassett hound's. A dozen heads around the conference table nodded agreement. "What's next?"

"A new 160 series with type 148, 205, and 246 characteristics. The season opener is a 25."

"Back to the basics, huh? I like it. What's the advo index?" Stokefodder leaned back in his big leather chair. It creaked in anguish.

"760."

"Great. Put it on right after 'Daisy loves Cletus.' OK, that leaves one hour. What else ya got?"

"Something a little different. This is a new science fiction series about colonizing space. They've done a pilot, it's great, and they gave me plot outlines for the whole season. They have top talent and a survey that shows a sizable and potentially loyal core audience, and fairly broad appeal."

"Is this that spin-off of 'Battlestar' I heard about?"

"No, this is done by a new production group the L-5 society put together. They have a big coalition of science fiction groups behind them."

"I dunno. Run the numbers by me," Stokefodder mumbled as he lit a Havana.

"Well . . . that's kind of hard to do.

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The stories are a lot different from the normal stuff. Do you want to see the pilot?"

"For Pete's sake, Murray, how many times do we have to tell you we're running a business here, not some goddamn experiemental theater workshop. If you can't learn to work within the system, we'll find someone who can. Forget the sci-fi and put the 923 on, but tell them to put in more 1 and 2."

"Sex and violence, that's all that counts any more, I guess. Sorry guys, I did my best." Randolph Murray scanned the sad faces of the people seated around his living room. "They wouldn't even look at the pilot. Maybe we can try for a midseason slot."

"Why didn't they want to see the pilot? I know they would have loved it." The gray-haired woman in the blue jeans looked more hurt than the others, if that was possible.

"I tried, Cheryl, believe me, I tried. The problem is that they've got the whole program selection process down to a science. They have the plot elements and character types numbered and modularized, and they know just what each component will do to the ratings. They almost never look at pilots any more."

"That stinks! Whatever happened to artistic merit and creativity?" The speaker was a middle-aged man who looked as if he belonged in front of a blackboard.

"Dr. . . . Dr. Morris, isn't it?" There was a nod, and Randy continued. "Until they adopted this system a few years back, there was a lot of payola involved in the selection of new shows. Every year there would be a couple of months of hype, hoopla, wining, and dining. Most of the execs tried hard to do a good job selecting shows, but it's not easy to be objective when people with millions to lose are throwing distractions at you every minute. Too many shows had to be dropped at mid-season, and executives were losing their jobs over it. The system they have now stinks, but the dropout rate is down."

"Dropout rate my ass. Do you mean to tell me they think every plot has been written already?"

"No. What I mean to tell you is that certain plot elements and character types sell better than others, and they think they have those all numbered and ranked. Science marches on."

"There ain't no justice."

"Don't blame me, Larry, it's a law of nature." Randy extracted a binder of computer printout from his satchel. "Personally, I think the stories are great. Look, I brought a book, their most sacred of secrets, that has all the standard plots and characters laid out for you. Go over your stories and see if you can adapt them."

"And turn the series into the same kind of mindless garbage they have on every night?"

"Goddamn it, Cheryl, I risked my job suggesting that show in the first place, and I may be risking my life giving you this book. You can't find anyone else foolhardy enough to present this idea to the networks, so you'd better listen to me."

"Sorry, Randy. You're right."

"That's better. None of the other production companies even know for sure this book exists. You follow the book and maybe you can get the series. Don't

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follow the book and your project is dead. Your stories are fresh and original, and that's great, but put in a few things they know they'll like."

"OK, if that's the way it is, then we'll play their game." Cheryl pulled a red pencil from her purse. "Open the goddamn book and break out the wine. Let's rewrite a few plots."

"OK, Murray, what else you got?"

"This you're gonna love. It's got 205, 429, 125, 88, 76, 23, and plenty of 1 and 2."

"I love it already." Stokefodder grinned, showing the tobacco stains on his dentures. "What's the format?"

"650."

"Oh. Sci-fi, huh? I don't know. What's the production company?"

"Starship Enterprises."

"Never heard of 'em." Stokefodder's corpulent lips closed around the black cigar and expertly flipped it to the other side of his mouth.

"They're new, but they've got some of the best talent in the business," Murray explained. "Even Gene, George, and Steven are in on it. You wouldn't be taking a risk."

"Well, maybe. It sounds like it might be a good show.The problem is, we don't have any major advertisers looking for science fiction. Who's going to back it? Tell you what, you tell these guys at Spaceship Studios, or whoever they are, to call us back when they get a sponsor. Maybe they've got something there."

The group in Randy's living room just sat and stared at their feet. Randy broke the silence. "Hey, it could have been worse. If he had said he'd call you, you could have hung it up. He likes the formula. All you need to do is find a sponsor."

"But who?" Cheryl asked.

"I've been thinking about that," Randy replied as he pulled a notepad from his pocket. "The companies who build space exploration gear would stand to profit by increased public interest in space exploration. Some of those companies don't even sell consumer products, but they advertise anyway to improve their image and sell stocks."

"Maybe the people who make video games and home computers would be interested," Dr. Morris suggested.

"Probably, but they're getting to be dirty words around the networks. A kid with a home computer typically uses it for two to three hours every night, so it cuts into viewership. The best sponsors make something everyone uses, preferably within earshot of a television. A toilet paper manufacturer is the ideal sponsor."

"Toilet paper is an appropriate product to advertise on most shows," Cheryl agreed. "OK, so we need to find a sponsor. I know L-5 has members who can do that sort of thing, and we should have plenty of members in management positions in the aerospace industry. Let's get to it."

"Now you're cookin' with gas, Murray. TRW and General Dynamics, huh? How much are they in for?"

"Between them, a half sponsorship for at least one season. They have a couple of others interested. You shouldn't have any problem filling the rest of the

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spots with minor sponsors."

"I shouldn't think so. Anyone have any objections?"

"Yes sir, Mr. Stokefodder. Those aerospace companies are a bad risk." The little man in the bright pink shirt and matching glasses was speaking. Randy had always thought he was just another of Stokefodder's flaky yes-men.

"Like how, Jones?" Stokefodder grunted.

"They're OK as sponsors for specials or as minor advertisers, but not for a full season commitment. You see, there's an election coming up, and those companies are after public support for space exploration. As soon as the elections are over, they might very well bug out. Besides, the average American spends more on potato chips every year than he does on space exploration. The aerospace companies don't have as much to gain as a consumer product manufacturer."

"Still, it's a good show, and the numbers say it would get good ratings. I'm sure we could get other sponsors."

"Mr. Stokefodder, have you seen the pilot?"

"Yes, I did. It was a little over my head, like 'Battlestar,' but I liked it."

"Well, here's the advo index, hot off the computer. See for yourself if we could get other sponsors."

"Jee-zus! Only 220. That settles it, Murray. It's dead."

"Dead! Why?" Cheryl had a coherent, monochromatic fire in her eyes that could have burned through plate steel. Some of the others showed traces of tears.

"They don't trust the staying power of your sponsors," Randy explained. "More than that, they have a new thing called the 'advo index.' It's a measure of advertiser support."

"I thought you said they projected good ratings!"

"They do. The audience would love it. The problem is, the audience it would draw isn't the one the advertisers want to reach."

"What do you mean? I have statistics that show science fiction buffs have a higher median income than the general population." Dr. Morris began poking through his breifcase.

"Then your statistics should also show that science fiction fans are better educated and maybe even a little smarter than average. That's the problem. The one group that won't match the show is the least common denominator."

"Let me guess. The advertisers aim at the morons?" Dr. Morris looked up from his breifcase in disgust.

"Isn't it obvious?" Randy continued. "Advertising affects everyone, but it affects morons disproportionately. On top of that, the government sees to it that even the morons have some money to spend. The advertisers get the most bang for their buck when they can target the bottom thirty percent or so of the population."

"And so the networks play along," Cheryl surmised. "Every year there is less and less programming worth watching. And it probably also explains why there is so little useful information in most commercials. Damn!"

"Wait a minute," exclaimed a neatly groomed man in a business suit, "I think maybe we can get a discrimination suit out of this. Intelligence discrimi-

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nation! If the teacher's union can win a suit that prohibits giving incentives to teachers on the basis of ability, then maybe we can stop the networks from denying programming to an entire class of people on the basis of brains."

"Do you think it would work?"

"I'll find out. I can't think of anyone who would be madder at this turn of events than the legal committee. They're all Mensas."

Cheryl opened the door. It was Dr. Morris. He entered and looked around the room. There were faces missing from the usual steering committee sessions. "Sorry I'm late. How come I don't see Randy and Larry?"

"I didn't invite them," Cheryl said, handing him a glass of burgundy. "What I have to say tonight, they shouldn't hear. Have a seat."

"How did things go in court today?"

"The bastards got the case thrown out. I think they got to the judge."

"They got to an Appeals Court Judge? I didn't think it was possible."

"It is. Political pressure. The Administration doesn't want a controversy over the rights of the intelligent. It would screw up every affirmative action program there is. The Supreme Court will refuse to hear it. We're dead in the water."

"Isn't there anything we can do about it?"

"That's what we're here to discuss. What I am going to suggest, some of you may not want to be involved in. That's why I didn't invite Larry, Randy, and Jacob. This can't be done with any affilliation with L-5, Mensa, or anyone else. Do you understand me?"

"We don't understand it, sir. The plots just scream toilet paper. The numbers are right. We think Squeezit's new spots must be rubbing people the wrong way."

"I just got a call from their advertising manager, and he says their tests show those ads are the best they've ever made. He pulled support from the show. He was furious, and he isn't the only one. In the past few weeks, twenty-five sponsors have reported reduced sales following every show they sponsor. It can't be a fluke. I want answers, Jones, answers. Or I'll get them by divining entrails. Yours."

"Did you do it to a Squeezit commercial last night about 10:30?" Cheryl asked as Dr. Morris put the shopping bag on the table.

"Yup. How'd you guess?" He eased into a weary but comfortable recliner.

"I'm mad, and I'm not going to take it any more," Dr. Morris said with a grin. The others nodded.

"Anyone want to leave now?"

No one did.

"Good. This is war, and the enemy is the networks. All three of them. Does the council of war of the Most Uncommon Denominator Liberation Front have any suggestions on strategy?"

There were a number of suggestions, most of them illegal, and some of them were good for twenty years to life. A few sounded like great fun, but none of them really addressed the problem. Through it all, Dr. Morris remained silent, but there was a smile slowly forming on his lips. He was grinning from ear to ear when he finally spoke.

"The thing to do," he said, "is to

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hit where it counts. Our whole goal is to change the approach of advertising away from the least common denominator. How many of you know anything about my field of research?''

Nelson Stokefodder was shaking, and the blood vessels in his bulbous nose looked as if they were about to burst. He slammed his fist down on the desk hard enough to knock an antique inkpot onto the floor. An assistant rushed over to clean it up. The little man in pink-tinted glasses stood meekly in front of the desk, like an effeminate convict awaiting a death sentence.

''Damn it, Jones, this system was supposed to be foolproof. We spent five million on it, and what do we get? For three weeks in a row, Squeezit bathroom tissue has had a thirty percent drop in sales for the two days following 'The Hart Massacres.' What the hell is going on? Your computer says that show is supposed to be perfect for them.''

''I found myself using newspaper rather than touching a roll of the stuff.'' Cheryl blushed. ''How'd you do it?''

''Dried corn cobs.''

''Incredible! I didn't realize you could make someone avoid a particular product. That's scary!''

''Subliminal stimulus research has come a long way since the '50s,'' Dr. Morris explained. ''Back then, about the most researchers could do was make people hungry by flashing a subperception message on a movie screen. Now we can do more.''

''I didn't know anyone was still researching it. There was such an uproar back then.''

''It isn't the sort of thing you advertise, but it reveals a lot about brain function. Not only have we been studying it, we've gotten good at it. We can't make anyone do something against his conscience, but it isn't hard at all to make him avoid a particular brand.''

''Do you think the networks will ever figure it out?''

''Maybe, if they ever analyze a locally recorded tape frame by frame. If they figure it out, so what? There are a thousand places in the system to inject a little bit of extra signal, and it's so easy to do. You wouldn't believe how many network technicians and engineers are die-hard science fiction fans. The networks can't stop us.''

''Do you think it will work?''

''You already know it works. A month from now, when they select next season's shows, they'll have abandoned the old system. We'll have the same chance as everyone else.

''Oh, by the way,'' Dr. Morris continued as he reached into the bag, ''I brought you a roll of Cottonette.'' ■

● "Freedom" has no meaning of itself. There are always restrictions, be they legal, genetic, or physical. If you don't believe me, try to chew a radio signal.

Kelvin Throop,III

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brass tacks

Dear Mr. Schmidt:

I know that subscriptions should go to the Ohio address, but I especially wanted to bring both this subscription and its *raison-d'etre* to your attention. Please find enclosed check to pay for a year's subscription of *Analog* to be sent to Cristina Wigert of Blossburg, PA.

As a Regional Science Fair director, I have been deeply concerned with the question of how to promote more creativity, "off-beat" thinking, and general originality. As a long-time reader of science fiction (it all began with Buck Rogers, in 1930, and has since 1938 continuously included *Analog*, under both its and my various guises), it has been my contention that *really* what we find in science fiction are depictions of a variety of possible universes. Finally, even my worn synapses made the connection, and this year I offered a subscription to *Analog* to the student whose entry showed the most "strangeness."

The young lady who received this prize had found her topic in one of those newspapers which are located near supermarket checkout counters. In it was a claim that placing a baby in a marketing cart was dangerous to one's health because an assortment of bacteria would be left in the cart, particularly if the baby's diaper had been soiled. She carried out an exhaustive series of tests upon carts in several stores and found absolutely no evidence of such bacteria.

When comparing this project with others (some of which were very complex and technical indeed, e.g., laser-transmitted television), I think that I was struck both with the source and with Ms. Wigert's willingness to consider as possibly untrue what would seem to be a prima facie assertion.

True, this project could not be claimed to be even potentially world-shaking,

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but it was certainly distinctly different from the usual science fair project. It is my hope that, as this award for originality becomes more generally known in our Region, there will be more attempts to break away from what might be called the traditional science fair presentation.

It has happened that I have been asked what I am really looking for. It almost always seems to be very difficult for such a questioner to understand my answer: "If I knew, then, of course, it wouldn't be original and strange."

Perchance you may wish to print sections of this letter, because it should be brought to the attention of your readers that anyone may similarly promote "offbeat" creativity. Science Fair directors are always looking for more awards. To discover who is in charge of the Science Fair in your area, ask the science teachers in nearby high schools. If they don't know then write to the following address:

Science Service
1719 N Street NW
Washington, DC 20036

and ask where the Regional Fair nearest to you might be.

RICHARD MASON

Dear Readers:

The relentless forward march of science and technology follows a *pendulum* pattern. Advancing knowledge and skills making possible production of jet bombers to kill more people in shorter time at greater distance, then made possible the *pendulum swing* in the opposite direction, producing jet transport planes bringing people and places closer together in a new world community.

The last generation self-generating arms and power race producing weapons capable of exterminating or dominating world populations has now made feasible, for the first time in history, the most exciting, complex and rewarding generation of creativity in history, pioneering world-sized systems and institutions guarding the national security, political independence and economic progress of all 158 or more nations . . . as air traffic control guards the safety and progress of all airplanes in a cloud. *The pendulum is about to swing*. Advancing systems technologies can provide the operational foundations for a future civilized world order. Technologies now designed to defend one nation can be harnessed into all-nation defense institutions, defending humanity against war itself. I will mention one small field opening up rapidly, perhaps to set the direction and the pace for a generation of creativity in all professions.

"Space" is only one aspect of National Power or future World Power Stabilization. "Intelligence" is only one instrument of power management, national or global.

Information is power. He who commands future intelligence satellites will be in a seat of power in the heavens not far from where mythologies once claimed God sat. One U.S. LANDSAT orbits the earth in about 90 minutes. It records everything recognizable in a swath 115 miles wide in computers on the ground. Every 18 days it "inspects" the entire planet and its 158 nations and the oceans. During the 18-day period it has been scrutinizing U.S. territory only 1.8% of the time. 98.2% of the time it has been observing foreign territory. There is no way this new technological frontier can be treated as a domestic American policy matter. The "foreign policy" of 158 nations was ruptured in the past generation. We now live in an unprecedented historic era of Global Power. In one 90-minute orbit this in-

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telligence satellite affects highest policy in military-technical-political-diplomatic -legal-economic-social-moral and other aspects of Government in every nation on the planet.

In 1978 the President of France called upon the Special Session of the United Nations General Assembly to study the feasibility of an all-nation satellite intelligence agency to help monitor, and provide verification for, future peacekeeping and common security agreements among nations. This was a vital step into the frontiers of a future civilized world.

With the U.S. and the U.S.S.R. abstaining, the General Assembly created a committee of experts from twelve nations (excluding anyone from the U.S. or the U.S.S.R.) under the chairmanship of Dr. Hubert G. Bortzmeyer of the French space agency C.N.E.S., to conduct the feasibility study.

After four years, this historic 123-page analysis of the technical, legal, and financial aspects of a global satellite monitoring agency was completed. The Kremlin and the White House acted to prevent the study from appearing on the agenda of the Second Special Session of the General Assembly in New York in June 1982, and of the U.N. conference on peaceful uses of outer space (UNISPACE 82) in Vienna. Still attempting to have the matter discussed and explored publicly, the "in-between" nations then voted in the General Assembly to have the study published as an official U.N. document. The U.S. abstained. The U.S.S.R. voted "no."

But the feasibility study now has been published in five languages (French, English, Russian, Chinese, Spanish) under the title: E.83.IX.3 *The Implications of Establishing an International Satellite Monitoring Agency* (US $12.50).

This giant stride forward into new history is now available for intensive in-depth analysis in universities, law schools, institutes of technology, seminaries and military academies . . . in professional societies in all fields . . . in Parliaments . . . in strategic planning and policy planning centers . . . and among all groups and persons concerned for a worthwhile future in which advancing knowledge and skills can be directed toward production of food, clothing, housing, energy, clean air and water, health, education, and national security in all nations. Not only will such all-nation global information services help provide verification for future global security agreements among nations, they will provide endless opportunities for new world-sized service institutions offering a better future for humanity as a whole.

The people of all 158 or more nations yearn for (1) defense against threats from foreign powers and (2) economic progress for their future generations. The nation which emerges to provide inspiration and leadership for all other nations in the coming generation will NOT be the superpower continually "winning" the race for weapons capable of exterminating or dominating humanity. Rather it will be the nation(s) with leadership capable of (1) meeting all defense requirements; and in addition (2) leading all nations in a new kind of "race," pioneering unprecedented world systems and institutions capable of assisting all nations and all people in their struggles for food for the world's hungry . . . clothing for the world's naked . . . shelter for the world's shivering . . . medicine for the world's sick . . . education for the world's illiterate . . . and a worthwhile future for the people of all nations and their childrens' children.

In addition to meeting all defense re-

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quirements the White House could take such unilateral initiative toward experimental life support systems for Planet Earth . . . or the Kremlin could take such unilateral experimental initiative. But neither the White House nor the Kremlin chooses such an initiative.

The 156 or more "in-between" nations are awakening to the new reality that no one of them ever again will find its own national security or economic progress by clinging to either Kremlin or White House side of the runaway race for weapons of annihilation or domination. That is why the "in-between" nations are today rallying around and seriously discussing the new United Nations document E.83.IX.3 as one experimental thrust through the Survival Barrier. It remains a "forbidden subject" in the Kremlin and the White House.

No military commander-in-chief of any nation ever again can live up to his sacred covenant, to provide for his own citizens' security, until there are world-sized security and development systems and institutions . . . a goal now within reach of a massive creative effort, in addition to defense requirements. I am not seeking political support. I am attempting to open pro and con and expansive professional, public and political Dialogue of Life and Hope before, soon, it may be too late.

HOWARD G. KURTZ

Howard G. Kurtz is Co-Founder and President of War Control Planners, Inc., a nonprofit organization whose work toward systems for ensuring world peace was mentioned in Arthur C. Clarke's recent guest editorials. Readers interested in obtaining more information or supporting the group's efforts may write to him at War Control Planners, Inc., Box 19127, Washington, DC 20036.

Dear Dr. Schmidt:

Re: Your February '84 Editorial: Having been a constant reader since the inception of Astounding Stories, I have the audacity to take gentle issue with you on your position that economics and psychology do not (cannot?) qualify as sciences because they do not (cannot?) predict reliably under test conditions.

I have a theory. Stated succinctly, it is: predictions by modern economists and psychologists originate in ideology, not in observation and inference. This is the root cause of their lack of precision.

John Maynard Keynes developed a working theory of economics, which gave politicians the power to diddle national, and sometimes international, economic conditions. Keynes, the more fool he, expected the diddling to be performed in furtherance of economic objectives. In fact, politicians are incapable of acting on, or even understanding, any objective not political. And what is the political objective, however disguised? Power over the people.

Further, given this intoxicating power, politicians were unable to resist using it so often, for such trifling purposes, that they wore it out. Heisenberg's third principle applies: observation affects the thing observed. Or, paraphrasing Mr. Lincoln, the people won't be diddled forever.

Dr B. F. Skinner developed the Behaviorist School of psychology, in which he postulated, and later demonstrated, that patterns of behavior in living creatures could be programmed quite without regard to the level of intelligence of the minds concerned. What would work for a pigeon or a dog would work for a man. This gave politicians and, for that matter advertisers, the terrifying power to build delusional structures, largely through the media, within which

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we are (most of us) expected to respond to "Operand Referents" in a rote manner. How far can this process be carried? See the scientific test conducted at Jonestown, Guyana.

Very fortunately, Behaviorism is beginning to suffer from the same defect as is Keynsian Economics. The temptation to use it so often, and for such trifling purposes, is irresistible. It too is beginning to wear out.

This is not to say that economics and psychology would not be sciences if they were pursued as sciences. But when pursued for the purpose of converting one or another ideology from myth to reality, the predictions are constrained by the ideology. Therefore, they are not too likely to fit into the discipline of science.

HOWARD W. MARTIN

St. Louis, MO

No, no—I didn't *say they* can't *qualify as sciences! In fact, I said I suspect they can—but only when they get different kinds of people approaching them in a different way.*

Dr. Schmidt,

Your editorial "When is a Science" in the February 1984 issue has suggested something to me. In it you propound the criteria that to be a science requires describing data in terms of operational rules by which anyone who understands them can predict—correctly and verifiably—what will happen in novel situations. I have no quarrel with this standard.

Then you point out that economics does not satisfy this standard. I also agree with you. But this implies that you think that it ought to and is not a legitimate field of knowledge if it does not. And with this I disagree. By the standard you have given, economics is *not* a science and I would never mean to claim that it was. I would claim that it was a legitimate field of knowledge which has accomplished much and is important to understand.

I hope you will not claim there are no legitimate fields of knowledge that are not sciences by your criteria. Counterexamples are (1) mathematics, (2) chess theory and (3) linguistics. And I would contend that economics has more in common with each of these fields than it does with, say, physics. Indeed, I would identify the subject of economics (which I admit is a very poorly chosen term) what we can say about the properties and consequences of human choice and purposeful behavior which does not involve particular facts or predictions. Surprisingly this is much.

CRAIG SPENCER

Eastsound, WA

I have never *claimed that there are no legitimate fields of knowledge that are not sciences!* ■

● A mere increase in the deadliness of armaments would not bring peace. The difficulty is that the action of explosives is too limited; to overcome this deficiency war must be made as deadly for all the civilians back home as for the troops on the front lines. . . . War will instantly stop if the weapon is bacteriology.

Alfred Nobel

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Eric Vinicoff

REPAIRMAN

Lieutenant Commander Tadashi Nakagawa studied himself critically in the lifespace's roll-down Mylar mirror. Dress black-and-silvers impeccably pressed and stretched taut over his lean frame. "Just like the recruiting poster," he observed.

"Too true," Marta said from the flight board speaker. "Join the Patrol. See the solar system. Veg out while your partner does all the work."

Tadashi sniffed himself. "*How about it? Am I an olfactory embarrassment?*"

It took her atmosphere analyzer a few seconds to collect a sample and test it. "Well, they won't have to evacuate the base. But you should have gone easier on the red meat."

"Who knew they were going to call us in from patrol? I thought we had eighteen more months of peace and quiet." He started for the airlock hatch.

"Aren't you forgetting someone?" Marta snapped.

"Don't tempt me." He pulled a remote from its rack, hooked it onto his belt, and stuck the earplug in his left ear. "Okay?"

"Okay," she said through the plug.

He went out through the lock and started down the ramp. *PSS Callisto* sat in its cradle, a bright white oblate spheroid already the center of attention of numerous maintenance-robs. Other occupied and unoccupied cradles were the dominating features of the vast cavern that was the Port. The gravity was about one-third g here near the Core.

Circum-Jupiter was a typical space community. Originally it had been an asteroid captured by Jupiter. Now it was honeycombed, reshaped and largely remade. A ship launching/landing linear accelerator ran through its long axis, and it spun on said axis to create simulated gravity. Its permanent population hovered around 60,000.

A car was waiting at the foot of the ramp. A young lieutenant bowed and held the door for him. "Admiral Osato's compliments, sir. I am to bring you to the meeting."

He climbed into the back seat of the fat-tired electribug; the lieutenant drove. They left the Port and followed wide streets through the industrial district. The traffic was rush-hour heavy. Cherry trees lined the curbs, scenting the air. The holographic "sky" was warm and sunny. Ramps took them to lower levels, past businesses, farms, schools, homes, and myriad pedestrians. Gravity increased to almost Earth normal.

He tried to stay calm by running through some mental drills, but failed. "What's bugging you?" Marta demanded in his ear. "Your pulse and res-

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piration are heading for the cometary belt."

"I'm not used to urban crunch," he whispered back. The lieutenant heard him, but she had seen the earplug so she kept quiet.

"You never were. Who else but a social defective would opt for solitary patrol duty."

"Hey, you're supposed to be my friend."

"I'm the kind of friend you need to keep your head vac-tight, darling. If you have any complaints, take them up with my programmers."

Tadashi sighed. Once, just once he would like to come out with even a draw.

He had expected to be driven to the Patrol's Outsystem HQ admin center. But the bug pulled into the parking lot of a long building front that he recognized with a considerable shock. He didn't need the aluminum block sign reading: PLANETARY STUDY INSTITUTE —AUTHORIZED PERSONNEL ONLY.

"Damn," he breathed. "They couldn't be starting *that* up again!"

"And if they are?" Marta asked.

"I sure hope I'm not being re-re-cruited. I served my hitch. Swimming around Jupe's soup in a bio-form nightmare body trying to start conversations with twenty-kilometer ammonia-base amoebas. By dint of long and arduous effort we determined they just barely hold an intellectual edge over celery."

"Without me along, you're lucky you made it back alive."

"Does it surprise you that I can perform duties on my own?" he asked bitingly.

"It would if it were more than a statistical fluke."

The lieutenant parked in front of the entrance, and Tadashi went inside. The reception station studied his thumbprints for a moment; then a cheerful pseudovoice said, "Good morning, Commander Nakagawa, and welcome to PSI. Your meeting is about to begin in Room 417A. Please follow the holographic guide."

Somewhere in this sober and serious institute lurked a whimsical sense of humor; instead of the usual glowing ball Tadashi found himself following a miniature fire-breathing dragon through the busy corridors.

He entered Room 417A diffidently. (The dragon vanished in a puff of smoke.) It was a small meeting room with an oval conference table, beautiful paintings of Jupiter, and four chairs. Three were occupied.

"Welcome, Commander," Admiral Osato said as everyone bowed. He was wider than Tadashi, with an age-wrinkled face and very erect posture. He introduced the old man and woman in civilian suits as Doctors Inamuri and Kaga respectively.

"Very prominent in biochemistry and astroengineering," Marta filled him in. "Currently part of the Far Traveler project."

Far Traveler? He knew about it, of course, but didn't see how it could involve him.

An aide brought tea for four. Between sips Admiral Osato said, "Please forgive the haste with which we must proceed. We are facing an inflexible deadline. Are you prepared to accept a new assignment at once?"

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"Yes, sir."

"Very good. Due to its unusually hazardous nature we are looking for a volunteer. Dr. Kaga, if you please."

The leathery female gnome studied some data on the screen built into the table before her. "As I imagine you know, Commander, the Far Traveler probe was launched from our accelerator eight months ago. It is now twenty-three light-days from here, on its proper flight line to the Tau Ceti system. The probe is directed by a combination of laser telemetry and the inboard computer system.

"Three months ago we began to observe, ah, abnormalities in some of the probe functions. None of them major, none that as yet threaten the success of the mission. But they may, because we have not been able to determine their cause."

"Abnormalities?" Tadashi asked.

"Admittedly a curious term, but I know of no better one. No possible malfunction or combination of malfunctions tested in our computer models can explain what is happening. The inboard computer system generates occasional indecipherable telemetry sequences. Equipment seems to, ah, activate and deactivate without cause." She coughed. "Some of our junior technicians have suggested gremlins."

"We have done everything we can by remote control," the admiral said. "Our first extra-solar probe is much too important to allow any possible risk to go unresolved. Therefore we intend to send a repairman out to the probe to investigate and take any necessary action."

"Watch out," Marta whispered. "This sounds like a body-bag mission."

Suddenly Tadashi caught the connection between PSI and Far Traveler's trouble. "You want to transmit me aboard the probe?"

"Exactly," Doctor Inamuri answered. "The probe contains transmission and cloning equipment in the hope that the probe might find an Earthlike world circling Tau Ceti. If so, we plan to transmit a team of researchers to study and colonize the world."

"I don't understand why you want to send me, sir. Why not one of the techs who built the probe?" Tadashi asked the admiral diffidently.

"Several reasons. As a solitary patrol commander you have a technical and practical background in space vessel repair work. Specs for the probe can be given to you and your partner—she would of course go along. But your major qualification is your previous experience with bioform transfers during the Jupiter study. The . . . psychological problems greatly reduce the number of qualified persons."

Silence. This was the point at which he was expected to volunteer. And he would, of course—the disgrace of doing otherwise would make life literally unbearable. But saying the words wasn't easy.

"If you don't decompress, I'm going to have to call a doctor to sedate you," Marta whispered sternly. "We both know why we're it—ever since we let that derelict alien starship get away, we've been at the top of the dirty job list. But we're going anyway, so why agonize about it? Calm down. I'll get us back."

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That was only part of it, as she well knew. He had taken a subjective approach to the core question of transmitting the first time around—but he was older now, and less sure of his answers.

He stood up and bowed. "I accept the assignment, and thank you for the honor it brings me."

The admiral returned the bow. "Very good, Commander. We must proceed promptly. The deadline I mentioned is that in eighty-seven days the probe will reach the certified maximum range of the inboard transmitter's ability to return you. We will transmit your genetic pattern today. After twenty-eight days for the growing of your clone bioform you and your partner will follow. That will leave you approximately thirty-four days to resolve the problem."

"Are there lifespace facilities aboard the probe, sir?"

"You'll be fully briefed during the next twenty-eight days. But the first order of business is the cell sample for your genetic pattern. Doctor Inamuri will escort you to the medical section. Your schedule has already been given to your partner."

Everyone bowed. After Admiral Osato and Doctor Kaga left, he followed the old man to the alcohol-scented PSI medical section. First came a long, uncomfortable (and unnecessary, Marta complained, since she kept constant telemetry on him) medical examination. Then the cell sample was taken.

Finally he found himself in his assigned guest quarters—small by urban standards, but spacious compared to *PSS Callisto*. As he sponged off in the lavatory before taking a hot mist bath, the events of the day caught up with him. He felt a weakness not due to the simulated gravity. "Well, Marta, open mouth insert foot."

"Only one of us has the anatomy for that, big mouth."

The twenty-eight days passed quickly. He slept in hypno-educator chairs. (Marta was having her database fed too, but redundancy was SOP.) They went to HQ daily and worked problem after problem in the probe simulator. He discussed theories with project personnel, and spent many hours in the telemetry center watching the futile efforts to solve the mystery.

On the morning of the transmission Admiral Osato personally escorted him to the PSI bioform transmission lab—the same grim room he knew well from the Jupiter study. Far Traveler was a Patrol project, but PSI possessed the only complete bioform facility beyond the Belt.

The circular floorspace was roughly thirty meters across. There were four couches, like surgical couches but with more than the usual complement of electronic, mechanical, and chemical equipment. A team of six white-gowned men and women headed by Dr. Inamuri was busy at one of them—his. White plastic, silver metal, and multicolored displays glistened all around. More equipment lined the curved wall. Above the wall glass panes revealed the monitoring room, and a dozen or so shadowy figures at consoles. Alcohol cut through the air.

Tadashi entered the lab naked except for a sterile gown and sandals, having been given a thorough scrubbing in the ready room. His gaze moved irresistibly

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to the morguelike wall section inset with twelve-meter-wide glass hatches. Inside three of them he could see bare, unmoving feet covered with a thin sheath of frost; he wondered where those minds were, and in what physical form.

One hatch was open. The empty coffin-interior waited patiently.

Admiral Osato stood at a monitoring room window, watching with massive calm.

"Final com check," Marta said through his earplug. She was speaking from *PSS Callisto*, but her database, including continuous updating, was being stored in HQ's computer system for transmission.

"Got you five by five," he answered. The throat mike was a coin-sized black plastic disk glued in place.

"Any last request?" she asked. "Cigarette, blindfold?"

"How about a good seat at your court-martial?"

Dr. Inamuri stepped forward. After the bows he said, "We are ready for you, Commander. Are you prepared mentally and physically?"

Tadashi stared at the couch and swallowed hard. At least the body waiting for him was a clone of his own. He would lie down, fall asleep, and wake up aboard the probe. And if the laser pulse carrying his mind missed its target, or got hashed, he would sleep forever. No big deal.

"Yes, Doctor," he lied.

The gowned figures positioned him on the couch, strapped him down, hooked him up, and wired him in. He turned inward from the disturbing activity, commending himself to his ancestors and family gods. Even Marta couldn't help him now.

Dr. Inamuri said something into his throat mike, and the universe went away.

Although the technology of transferring a mentality from its original body into a duplicate or altered clone is well established, a basic question has yet to be resolved. Since this question is legal and religious as well as scientific in nature, it has severely limited the use of this technology despite its awesome potential—particularly in the medical field.

The question can be simply put. Is transmission a replication or a true transfer? Proponents of the transfer view point out that the original body is emptied of all mental activity, even the purely involuntary functions, and therefore must be kept alive by life support. Also, no attempt to record the transmission pulse—which would make multiple replication possible—has ever succeeded. The reason for this failure, and even the exact nature of the pulse itself, are still subjects of vigorous debate.

The replication proponents argue an analogy to communication and the immutable nature of the soul. A final answer, if one is ever reached, remains far in the future.

Introduction to Bioforming
Itachi Kurosawa

Tadashi spent a long time waking up, so much so that he had no definite idea when consciousness actually returned. He gradually became aware of sensations, and some of them weren't right.

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He felt weak. His muscles seemed oddly slack. He was cold and damp. And something was wrong with his nervous system—as though he had been taken apart and reassembled slightly out of true.

His memory returned in chunks. When the recent ones showed up, he understood the strangeness. He had made it. He was in the cloning cylinder aboard the probe. The air was thick with the indescribable, unforgettable reek of neo-embryonic fluid, and he lay face-up on the metal latticework of the muscle toning gear. His slight weight matched the acceleration of the probe.

He felt pleasantly drowsy, and would have liked to nod off again. But there was a job to do. And something else was wrong. What . . . ? Of course, Marta. She should have been nagging in his ear by now. "Marta," he croaked, "are you all tucked in and ready to get to work?"

No answer. Worry made him open his eyes.

And wish that he hadn't.

The glass faceplate of the cylinder was foggy, but he could make out the probe's small control deck. The lights were on; the other life-support systems were obviously in operation too.

Obviously, because Tadashi wasn't alone aboard the probe.

A . . . being was sitting at one of the flight stations, the seat swiveled so it could look at the cylinder. The being was human-shaped, but by no means human. About two meters tall if it had been standing, and surrealistically thin, it had rather crudely altered a flight suit to its physique. The hands had three long, slender fingers and an opposable thumb. The face was enough to make Tadashi queasy; a round mouth with squirming chelae instead of lips, bulging bug-eyes, ears like seashells, no hair but a bony ridge like a cock's comb, and what looked like a pair of button noses on the cheeks. The visible skin was red and scaly, the scales shrinking and becoming red leather on the face.

Then there was the tail—about a meter long, scaled and rust-colored. It was undulating slowly.

Tadashi ran through a quick series of mental drills to calm down, then considered his next step. Marta was missing—no help there. He could open the hatch and make a personal introduction, but that didn't appeal to him. He decided on the com.

The cylinder's controls were beside the faceplate. He touched the com switch. The motion was as weird-feeling and awkward as he remembered. His first try at speaking resulted in a coughing fit. The second succeeded.

"Er, hello," he said, expecting to be heard but not understood. "You're from out of town, aren't you?"

"Humor," the alien commented. His voice sounded like something produced by a steel-string guitar. "A sign of mental stability. Good. I was afraid the shock of my presence might make a rational discourse impossible."

"Your Japanese is excellent."

"Thank you."

Tadashi was thinking. The situation had gotten totally away from him; he had to catch up fast. "Since it's not likely you picked it up on Earth or a space community—you would have been noticed—you must have learned it from the inboard computer."

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"Of course. Your translating program is crude, but you should be pleased to know it works. If there were intelligent life in the Tau Ceti system—which by the way there isn't—your image/sound/word association technique would indeed have deciphered the languages."

The tone of the conversation was encouraging. He couldn't hide in the tube indefinitely, and he was cold and uncomfortable. "Excuse me while I leave the womb," he said, and touched the hatch switch.

Nothing happened. He reached for the manual override, but the lever had been broken off.

His fortress abruptly became a prison, and a claustrophobic one at that. "How about letting me out?" he asked without much hope.

"I think not," the alien replied. "I feel a definite sense of security from this arrangement."

Tadashi's immediate future seemed to be tied to the bigger mystery. One step at a time, he told himself. "I'm Lieutenant Commander Tadashi Nakagawa of the System Patrol. I'm here to repair this probe."

The alien stood up and bowed. "I'm Professor . . . er . . . Professor Backbiter. Yes, I like that. I'm the source of the problems you came to repair."

"I suspected as much. Before we go any further, do you know where Marta got to?"

"Mar—oh, the simulated personality database that arrived with you. A curious creation. Very curious indeed. I stored it in the inboard computer's inactive memory. I plan to study it in detail later on."

Tadashi felt a surge of anger, and fought it down. He should actually be relieved she was aboard. Her situation was no worse than his.

"Which," he said diffidently, "brings us to the subject of why you're here."

"To study this artifact and collect a specimen, of course. Can't do any contact work inside your solar system *per se*—the damned environmentalists and their endangered species act—but when this crossed the boundary it became fair game."

"You have a starship nearby?"

"Nothing so primitive. All modern xenology is conducted by tachyon-based, er, fields of force . . . no, multiplex laser . . . I'm afraid I can't define it in your language, but it operates almost instantly over interstellar distances. The effect is somewhat as if I had a battery of electronic sensing devices out here."

Tadashi didn't understand the how of it, but taking it as a given the probe's problems and the alien's presence made sense. "You studied the probe by remote control, which fouled up our telemetry. Then you used the cloning equipment to grow yourself a body, and transmitted yourself aboard."

"Very perceptive. It happens we're both carbon-based, oxygen-breathing lifeforms—not surprising, when you consider that most intelligent species are."

"Why go to all the trouble of transmission? Your long-range methods seem pretty thorough."

"There's no substitute for field work. Also, I had to make sure that a repairman would be sent, and to welcome you properly."

Tadashi didn't like the sound of that. "How so?"

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"You're the specimen I came to collect. The only *Homo sapiens* ever brought in for detailed study. In a few minutes I'll begin the preliminaries for transmitting both of us back to the Xeno-Studies Center."

Tadashi thought for a moment, then said carefully, "I appreciate the opportunity to be my race's first ambassador to your world, but I have to respectfully decline. I'm bound by duty to complete my mission and return to report to my superiors." Nor did the idea of being a specimen for alien scientists appeal to him. Travel to exotic locales, like all pleasures, could be taken too far.

"I'm sorry you aren't looking forward to the trip—which for legal reasons will have to be one-way. But you're going nonetheless. Lie back and relax. I have to make sure the necessary replication equipment is ready, and transmit your gene pattern. Don't become distraught; you'll be very well treated. You're about to embark upon a fascinating future."

"If it's so fascinating," Tadashi snapped, "why don't you come home with me instead? We'll stick *you* in one of *our* labs."

"I was afraid you wouldn't take this in the proper scientific spirit." The Professor touched a button on the panel in front of him, and Tadashi could tell from the click that the com was dead.

As the Professor went to work at the transmission panel Tadashi shut his eyes. He didn't need to watch; he knew what was being done, from beginning to highly unpleasant end. Instead he considered what he could do to stop it. He was naked, unarmed, trapped in the cylinder, and limp as so much dead squid.

He wondered what life would be like where he was heading.

Dammit, he needed Marta!

A soft hissing sound.

He recognized it, of course. But was it an impossible reality or only a wish-fantasy? He looked at the Professor's back. Surely *he* hadn't triggered the release. An accident? If so, a damned convenient one.

What now? The hatch was open —maybe. A prison break was definitely in order. The Professor didn't look particularly tough, but Tadashi knew from experience just how feeble he would be until his muscles and nerves became reacquainted.

Unfortunately there would probably be no time like the present.

The hinge grinding would announce him anyway, so he opted for surprise. He kicked the hatch open and came out screaming.

"Haiii . . . urp!" His yell ended in a thud as he sailed over the Professor and bounced off a bulkhead. Low-g combat is an art requiring finely honed reflexes. His left shoulder took the impact at a painful angle.

The Professor looked up, screeched in what was probably his own language, and pulled something from his belt pouch. Tadashi recognized the diamond-edged cutter from one of the exploration packs.

Tadashi landed softly on the cold plastic deck. His attempted forward roll ended in a bellyflop. As he stood up the Professor left his seat, holding the cutter in an awkward but not ineffective pose.

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"I would like to bring you back alive. Corpses are so much less informative."

"You're forgetting I'm an endangered species."

"Only in your native habitat."

Tadashi was having trouble staying on his feet; he kept overcompensating. The Professor stepped forward. "Very well, if you must be stubborn—"

Tadashi knew what he wanted to do, and tried to make his body obey. He threw himself at the Professor's spindly legs. The cutter swung down, but he managed to knock it aside.

They collided, and bounced off the back of a seat. The cutter slid over by the cylinder. The Professor crawled to retrieve it. Tadashi figured his chances of getting there first, and went the other way.

The circular hatch in the middle of the floor opened on his second stab at the button. He dropped into the "corridor"—a tube barely wide enough for his shoulders—and was able to grab a ladder rung. The tube was dimly red-lit.

Rushing down the ladder was physically out of the question; he took the rungs one at a time, a painfully slow pace as well as just plain painful. He stared up at the circle of control deck light. Would the Professor come after him? And if so, what could he do about it? He was in no shape to fight or run.

The circle became a crescent as the hatch eclipsed it. With a soft jar the hatch sealed. Good news, so far. The Professor didn't want a second round just yet, either.

Tadashi hooked elbows over a rung, let his few kilograms dangle, and thought. His situation was improved only relatively; it still lacked quite a bit of being hopeful. He had the run of the probe, except the one place he needed in order to get home.

Below him the tube passed the hatches of living quarters and labs, ending thirty meters down at the bulkhead separating the lifespace from the machinery. Ideas came and went by the dozens. They all fell on a single point—there were any number of things he could use to force an entrance and take care of the Professor, but they were also likely to damage the delicate transmission equipment.

For the first time since waking he had time to look at his situation objectively. Hanging naked like a ham in a smokehouse, a long way from home, locked in mortal combat with a soft-spoken alien scientist. Marta would laugh herself sick when she found out.

It wasn't so funny when it was happening to you.

What the—?

He was gasping for breath, and not from effort or fear. His eyes hurt and his skin itched. Listening carefully, he heard hissing.

No wonder the Professor had sealed the hatch! Why risk anything as chancy as a fight when he could simply evacuate the atmosphere? After Tadashi's blood boiled, he could get a cell sample from the fresh corpse.

Tadashi started down the ladder the quickest way possible—he let go. At first he dropped in dream-like slowness, but rapidly accelerated. He opened his mouth wide to keep his eardrums from rupturing. The passing hatches didn't tempt him. Unless the Professor was unbelievably stupid, the air was being sucked out everywhere except in the control deck.

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He tried to cushion his landing by flexing his legs, but ended up sprawling on the bulkhead. He banged his knecaps hard enough that he stopped thinking about all lesser matters for a few seconds.

Colored lights swirled through his vision, and his lungs felt as if they were gasping vacuum. But it wasn't that bad—yet.

The airlock hatch was plainly labeled. He hit the OPEN button, and wasn't particularly surprised when nothing happened. The Professor had override capability in the control deck.

He sagged to the floor, fighting off a riptide of darkness and gathering his remaining strength for what had to be done. The manual control was for emergencies; it couldn't be overriden.

He crawled up the bulkhead, grabbed the lever and let his legs go slack. The lever swung, and the thick metal plug eased open. He crawled in.

The plug shut automatically. He heard air hissing, and knew he wouldn't die just yet.

Gasping, he lay still until the pressure reached E-normal and he felt relatively conscious. No bleeding, no pain suggesting internal injuries.

He climbed onto and stretched out on the suitmaker couch, trying to remember if there was a control deck override for it. It could be a worse trap than the cylinder. He didn't think so, so he switched it on. His coordination had improved to the level of the last day of a five-day saki binge.

The couch's lid came down, and he felt the unique sensation of the vacuforming process. When the lid rose minutes later, he was a bright and reflective white from toes to neck. Aside from the spacesuit's protection against vacuum, temperature, radiation *et al*, he found it a real morale boost to be clothed again. Boots, a helmet, and a life-support unit from one of the shelves completed his ensemble. As an afterthought he opened an exploration pack and took out the cutter.

All dressed up, but where to go? He felt like Ugh the caveman, faced with the age-old problem of getting the bear out of his cave. This historic first contact with an intelligent alien had degenerated into an unfortunate bit of social Darwinism.

Could the Professor be thinking the same thing? He switched on his helmet com. "Professor? Lieutenant Commander Nakagawa here. Alive and well, despite your best efforts."

"Actually, I'm very glad to hear that." The Professor's voice twanged in his right ear. "I'll have another opportunity to persuade you to come with me willingly."

"Forget it. If I ever pay you a visit, I'll want a roundtrip ticket."

"Wouldn't you prefer living to dying?"

Tadashi tried a sincere chuckle. "You're somewhat behind the times. I'm wearing a spacesuit, and I have the run of the probe except for the control deck."

"For the moment. Your point?"

"We're stalemated. I can't get to you without risking damage to the transmission gear. If you come out, I have a cutter too."

"An excellent summation, as far as it goes."

"Each of us would like to take the

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other home as a souvenir. I suggest a compromise. We each return home with a fish story—you know, the one that got away."

The Professor mimicked his chuckle. "I've spent months at a time brushing dirt from an alien ruin. Patience is essential in my field. I have control of the shipboard systems, and many ideas for taking you not yet tried. I must say I like my situation better than yours."

Tadashi shut off the com with a disgusted slap. The Professor was right.

He needed Marta's advice.

Marta . . .

He sat on a corner of the couch, ate two ration bars, and drank helmet water, then began the dexterity exercises he had been taught. The awkwardness wasn't as bad as when he had worn the body of an ammonia-base monstrosity.

Stretch. Bend. Flex fingers, one through ten. Walk in slow low-g steps. Turn. (Fall and get up.) Arms up, hands trace a box in the air. The suit carried his sweat and other excretions to the LS unit's recycler. Evaporation cooled him.

And he thought. The computer was the key to controlling the probe. The Professor held the primary terminal. Tadashi could get to a terminal in one of the labs, but the Professor would already have cut them out of the system.

The computer core was actually below in the engineering section. He could reach it.

And do what? Disable it? Feasible but suicidal—it operated life-support and transmission, among other things. Take control? No problem for a Ph.D. in cybernetics or a Computer Tech Five, but his computer repair skills were limited to replacing component modules.

Marta was in there somewhere. . . .

"Damn!" In his excitement he tried to move too fast. He rebounded off the ceiling glow panel, and landed in a series of bounces. He dug deep for all he knew about the inboard computer.

Inactive memory usually meant the auxiliary storage units. If that was where Marta was, she existed only *in potentio*. But it could also mean a blocked-off part of active memory. The computer had both capabilities. The Professor had said he planned to study Marta at his leisure. Wouldn't he use blocked-off active memory?

The "accidental" cylinder hatch opening!

Time for some quick action. At any moment the Professor might see his mistake—if he hadn't already.

Tadashi opened the plug hatch again, and stepped into the bottom of the corridor. Very circumspectly; the Professor could play a variety of pranks, like closing hatches in his face.

The lights went out.

He switched on his helmet lamp and com. "Aren't you being a bit petty?"

"The effects are meant to be cumulative."

Tadashi didn't even bother trying the floor hatch's button. He pulled on the lever, and started down the ladder while the hatch resealed.

The lamp gave him only a narrow, dancing view. He had entered the realm of the machine. The ladder descended through a cramped opening in the densely packed tanks, generators, pipes, cables *et al*. Grated catwalks were the only concession to its occasional human intruders. If there had been air he would

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have heard the sounds of its life; he did feel its pulse through the rungs.

The catwalks were numbered, and he knew where he wanted to go. The computer section looked like a canyon with dark metal block cliffs, twined with cable and pipe vines. Wisps of vapor from the supercooling system added to the air of spookiness. But he had more material fears to distract him.

He found the block he was looking for, and removed its front. Revealed were stacked circuitboards holding phalanxed black plastic boxes. One bank of the computer's active memory.

Starting methodically from the top, he pulled the boxes out the way he would to install replacement modules. But this wasn't a repair job. He piled them neatly on the catwalk.

A sharp siren rang in his helmet from the com. Sound alarms were also shrieking throughout the lifespace. The Professor, he thought with grim satisfaction, should be realizing his mistake right about now.

As the computer's capacity decreased, it took automatic action to preserve its vital functions. Non-vital functions were suspended. Needed replacement data was called up from auxiliary storage.

And all active memory was brought on line, vessel integrity overriding any blocks or other obstructions.

"About time you sprung me." Marta's griping voice in his helmet was the best thing he had heard in a long time. "I—"

"Stow it a moment. We have Professor Backbiter, the Alien Terror from Deep Space, to deal with."

"The BEM will keep. As of nine seconds ago, when I took over the computer, I demoted him from threat to prisoner. We—hold that thought. He's calling you on the com. Shall I make it three-way?"

"Make it no-way." Tadashi could well imagine the Professor was now in a garrulous mood. Tough. Let him stew. "How much do you know about all this?"

"Everything the computer knows from sound sensors, *et cetera*. Plus what I could deduce therefrom. The Professor thought he had me in a bottle, but I'm a lot more devious than your average program."

"So it *was* you who sprang the cylinder hatch?"

"None other. A very tricky piece of rerouting, that." Marta's voice became apologetic. "Sorry I couldn't do more. I'm glad some of my brains have rubbed off on you, and you figured out the solution."

"Nothing is solved yet." Worry put an edge on his words. "The Professor has a cutter, and he controls access to my way home. If you try to suffocate or freeze or boil him, he can wreck the transmission equipment. We may still be stuck in a stalemate."

"Are you up for something risky?"

"A little late to be asking me that."

"Point taken. Here's my plan."

She laid it out quickly. When she finished Tadashi just stood for a moment, feeling the suit suck up his sweat. "That's easy for you to say," he finally gulped.

"I'll be right behind you."

"Yeah. Pushing. You think the suit might deflect his cutter?"

"Let's hope it doesn't come to that."

"So we'll give it a try." He stared

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regretfully at the cutter in his hand, then dropped it onto the catwalk. Killing the Professor wasn't part of the plan. He felt air pressure returning.

"How's your coordination?" Marta asked.

"As good as it's going to get for a while. Good enough, I think."

He climbed out of the equipment section and up the ladder to just below the control deck hatch. No sounds penetrated the thick alloy. "What's the Professor up to?" he asked.

"Trying to talk you into surrendering."

"Huh?" Oh, of course; she had simulated his voice on many a boring log entry and status report. "Good distraction."

"Flatterer. Get ready."

"Check."

He switched off his lamp. The darkness dropped him into the remembered fear of childhood. He fought it off by running through mental drills, and knowing Marta was with him.

His eyes and nerves adjusted to the darkness. He was still blind, but he could handle it. "Go!"

He had a hand on the hatch, so he felt it rise. He heard the grinding sound of the motor. The Professor would too, and would take immediate steps.

The blackness endured. Marta had killed the control deck lights the moment the hatch started to open.

Tadashi jumped up through the hatchway. As he did, the crashing finale of Beethoven's Ninth Symphony hit him like an asteroid ram even through his helmet. Another distraction from Marta; he hoped the Professor liked classical.

"Three . . . two . . . one," Marta chanted supernaturally fast. Tadashi curled, spun and kicked off the ceiling as precisely as an Olympic swimmer's kick-turn. "Three . . . two . . . one," again, and he stood in the spaceman's impact-absorbing crouch beside the closing hatch.

The Professor may have been surprised, but not much or for long. He had a momentary advantage—he knew Tadashi had to be near the hatch—and took advantage of it.

"Down," Marta snapped, and down Tadashi went in a deep squat. Something heavy stirred the air as it hurtled over him. A sharp coolness scythed across his left shoulder blade, neatly parting the suit material but stopping shy of epidermis.

A loud thud of something hitting the wall behind him pierced the music, followed by a few sincerely uttered alien screams.

"180 degrees," said Marta. He stood and spun, trying not to think about how close the cutter had come. A knife in the dark is an almost instinctive terror.

"Three steps forward, on your left; he's on the deck but getting up." Marta was using the scanner system's infrared capacity to guide him in this weird game of blind-man's-bluff.

He moved carefully but quickly. "Right arm chop to four o'clock."

He delivered the karate blow as per instruction. His arm above the wrist hit what felt like a tree branch. He resisted an urge to howl and jump up and down hugging the arm.

"He dropped the cutter," Marta reported. "One step to the right. He's trying to crawl away. Bend and reach . . . no, lower."

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Suddenly he had two handfuls of flight suit. At the same instant something curled around his left leg.

"Watch out for—"

The leg was yanked out from under him.

"—the tail."

"Now you tell me!"

He fell on top of the writhing Professor. The alien kicked, gouged, hit and strangled with the thin but powerful tail. But the suit's toughness and his greater strength gave Tadashi the edge. They bounced around like jumping beans in the low-g. Finally Tadashi got the arms and legs (and tail) wrapped in suit repair tape.

The music vanished, and the lights came on. "Good job," Marta said. "We have quite a surprise for the admiral."

Tadashi sat on the squirming Professor to keep him in one place, and tried to catch his breath. "We? I'm the one who almost got diced."

"Would you like to turn him loose and try it again on your own?"

Tadashi shook his head. "No." He looked down at the ugly face staring at him. "You okay?" he asked after removing his helmet.

"As well as a mugging victim might expect to be. No serious injuries. Now that you have me, if I may ask, what do you plan to do with me?"

"I like your travel arrangements; we'll just reverse the roles. You'll find our solar system a fascinating place, particularly for one in your profession. Think of it as a chance to do the field work you haven't been allowed to do."

"I'm underwhelmed. Fortunately, it won't be necessary for me to endure incarceration among your primitive tribesmen."

"You think not?"

"Indeed. Set me in a seat so we can discuss the matter like gentlemen, and I'll explain."

Tadashi did so suspiciously, then dropped into another seat himself. He was exhausted—his new body lacked endurance as well as coordination. He was also hungry, thirsty, sleepy, aching, and in no mood to play riddle games with an alien who had been extremely antisocial. "I'm listening."

"You won't take me home with you, because you won't be going home unless we reach some sort of understanding. Before you regained control of the computer I took the precaution of removing the coordinates of your home transmitting station. I have them memorized."

Tadashi felt like a quantum black hole had just formed in his stomach. Without the coordinates, finding Circum-Jupe at this range would make the needle/haystack job look simple. Nor, without a signal to track, could Circum-Jupe find the probe. If the laser pulse that was him missed the receiver . . . well, eventually he would be the first human to leave the galaxy, but he would never know it.

"That true?" he asked Marta.

"I'm afraid so," she answered through the flight board speaker.

"Why didn't you tell me?"

"I didn't know. I had no reason to check that function until now. Sorry."

Sorry. Marta had so many strengths, it was easy to forget her weaknesses. Like no imagination. "Okay, Professor, let's discuss."

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"You can't get home without my help, and *vice versa*. I suggest that we compromise. We each return home with a fascinating tale but no guest."

Tadashi was afraid it would come to that. His superiors would be unhappy about the lost opportunity, but even without the Professor his report was important. He needed to get home to deliver it.

"Okay. Give me the coordinates."

"You'll forgive me if I don't trust you. Once I tell you the coordinates, I lose my bargaining position. I propose you allow me to leave. I will then send you the coordinates."

Tadashi laughed bitterly.

"We do seem to have a technical problem," the Professor said. "How do you suggest we overcome it?"

Marta coughed for attention. "MAD."

"MAD?" Tadashi and the Professor harmonized.

"Mutual Assured Destruction. A military deterrent theory. Each of you gets control of a weapon of total destruction. Obviously there is nothing to be gained from using them, except to prevent treachery from the other person. Think of it as an ultimate veto power."

"Quite logical," the Professor said. "Do you have any bombs aboard?"

"No," Tadashi said as he went to a storage compartment and pulled out two power cells. "But a bit of tinkering will make these serve nicely."

"Be careful," Marta warned. "One twitch and this probe will reach Tau Ceti as a dust cloud."

Tadashi used tools from the kit under the flight board. In five minutes he had two pocket fission bombs with toggle switch detonators. The Professor had watched closely, leading Tadashi to junk his vague notion of faking the modifications. He handed one of the black plastic cases to the Professor, and held the other very gently.

The Professor recited two long numbers.

"Does that sound right?" Tadashi asked Marta.

"Could be."

"Send a VSR plus a mission update—details to follow—and ask for a return pulse to confirm interlock. Schedule our return transmission."

"Aye, aye, skipper."

"If you don't mind, I'll be running along now," the Professor said.

Fear was releasing its stranglehold on Tadashi's sense of wonder; he was reluctant to part company with the Professor before he could get a few hundred questions answered. "I think you should stick around until we interlock with Circum-Jupe. Not that I doubt your coordinates, of course. We can have many fascinating chats while we wait."

"Better let him go now," Marta said.

"Huh? Why?"

"We have a deadline if we want to get home, remember? There's not enough time to wait for the interlock."

Tadashi began removing the tape from the Professor. "We'll have to trust your coordinates," Tadashi said. "I'm going to assume you wouldn't give me phony figures, since you expected me to test them before letting you go."

"Under the circumstances I can hardly disagree." The Professor went to the transmission board and touched several buttons. "I'm ready to depart—I set everything up before the tables turned."

He stripped off his flight suit and

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crawled into the cylinder—with the power cell still in one hand. "All in all, a very disappointing piece of research," he said, and shut the hatch. In seconds the viewplate was covered with mist.

Tadashi turned away. It was too much like death. A minute later Marta said softly, "He's gone."

Tadashi sagged limply in a seat. "Did you get any data on that tachyon-based communication system he claimed to be using?"

"I'm afraid not. Too much like trying to see with your ear."

Tadashi yawned. Adrenalin was no longer energizing him, and he felt lousy. "Marta, there are a few things we have to do before we can go home. One, get a cell sample from the Professor, transmit it and eject the corpse. Two, check the probe and make any necessary repairs. Three, make a program change in the computer to prevent any more unauthorized manipulation. Did I miss anything?"

"Medical treatment. Get thee hence to the sickbay medical unit, so I can fix you up."

Tadashi yawned again. "Okay. But then I need a substantial meal, and a lot of sleep. Bring the crew quarters to active status."

"Consider it done."

Tadashi started to get up, then stopped. He was farther from Earth than any human had ever been before, deep into interstellar space. "I want to see what's out there."

"Tourist," Marta muttered. But the holoviewer swung down from over the flight board, and he stuck his head into it. The probe's hull cameras fed their images to Marta, who collated them.

He saw none of this. He was the probe, seeing with its eyes. He saw space around him, ultimately black, spreading forever. No sun, no planets, no moons or constructions of humanity. But the actinic blue flame of the fusion ramjet lanced out behind him, and stars were everywhere, myriads upon myriads of them. White, yellow, red, blue, orange (Marta added the colors his unaided eyes would have missed), untwisted by relativity so early in the flight. Ghost-lights of nebulae. Black masks that were dust clouds.

"Are you glad we came?" Marta asked.

"I am now."

Admiral Osato's office was dominated by a holo projection "window" filling one entire wall. It showed a view of Jupiter from the research base on Ganymede. The sight was awesome, and so realistic that Tadashi flinched and almost yelled "Blowout!" as he crossed the threshold.

The admiral rose, and they exchanged bows. "Welcome, Commander Nakagawa. Please be seated. I trust you are well."

Tadashi's body still felt a bit like that of a stranger, but the PSI doctors assured him the transmission had gone perfectly. A few more weeks of exercises would complete his recovery.

The admiral stared at him levelly for long moments, then spoke. "You know too much about this matter, Commander. We must be certain that you will keep silent—or take action to assure that silence."

Tadashi would have felt a chill if it hadn't been dampened by his rising an-

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ger. "I'm a Patrol officer. Is my honor doubted, sir?"

"No. Which is why it has been decided to explain certain facts that have been kept from you. Then you will understand why secrecy is vital.

"Your brief encounter with the derelict starship two years ago told us that we shared this region of the galaxy with at least one highly advanced alien race of unknown intentions toward humanity. This lack of military intelligence had to be remedied. Project Far Traveler was already underway; we took it over and made certain changes.

"The ulterior purpose remained exploration. But the probe was actually bait, radiating signals we hoped would attract alien attention. A very faint hope, you might think—many of us did—but it was merely one aspect of a comprehensive intelligence-gathering operation."

"You knew the Professor was aboard?" Tadashi asked, barely holding his anger in check. "You sent us out there blind, into a trap—"

"The probe was a trap, true. But for aliens. It contained every sensing device known to our technology. When the telemetry troubles began, we thought that we had been successful. But whatever data the sensors were collecting remained in the probe's computer; the alien's tampering had inadvertently prevented its being communicated to us.

"So you were sent to make the necessary repairs. We had no idea an alien had actually boarded the probe. You weren't told the true nature of the probe's mission for security reasons. Your partner, however, was fully briefed."

"Marta?" Tadashi growled.

"Sorry, darling," she whispered contritely in his ear. "When they say top secret, I have no choice."

"So I was just along for the ride," he said, and some of his bitterness came through, "while Marta did your spy work."

The admiral frowned. "Your experience has understandably left you overwrought. The two of you were sent as a team; you functioned as a team to make the mission more of a success than we had dared hope.

"The continuing research into the exact nature of transmission has taught us much about recording mental activity. We haven't been able to record pulses and reproduce/duplicate living subjects—personally I doubt we ever will—but we do know how to record memories. When the alien transmitted himself home, your partner read his memory and brought the entire contents back."

That lifted Tadashi beyond his anger. The Professor's memory—what a magnificent prize! The greatest single addition to human knowledge ever made. Implications swarmed through his mind.

"Do you now understand the need for secrecy?" the admiral asked. "It will require much time for experts to evaluate the data and its possible impact on our society. The central issue—a threat assessment of the alien race or races—probably won't be answered from one alien's memories.

"But he did have a good grasp of the principles of tachyon technology. In not too many years we should be able to put our questions to the aliens personally."

Tadashi thought about that, and man-

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aged not to drool on the admiral's desk. "I understand the need for secrecy, sir. I thank you for allowing me the honor of participating in this achievement."

"Good. You will resume your patrol mission. You may go now."

Tadashi acknowledged the order, bowed and left.

Back in the busy corridors of Patrol Outsystem HQ heading for the Port entrance, excitement bubbled through him. He had a lot to think about, and time to do it. How could Marta and he get themselves assigned to the Patrol's first starship? "Begin pre-launch," he whispered to Marta. "We're on our way back to the serenity of the cometary belt."

"I know. Exiled to help us keep our mouths shut."

"I prefer to think of it as eighteen months of peace and quiet. Just you and me, Marta."

"Imagine my excitement." ■

● It's been a while since we had a collaboration by Eric Vinicoff and Marcia Martin, but our October cover story is one of their biggest and best. It's a long novelette that does very well something that too few writers bother to do at all these days: it takes you right inside a thoroughly alien culture and lets you see how it works. From inside, of course, it's a perfectly normal society—just the sort of thing you'd expect to develop among intelligent beings who happen to be carnivores. The *aliens,* as they see it, are the bipedal intruders whose presence threatens to disrupt their whole social order and the concepts on which it is based. Which, of course, can be an uncomfortable experience. . . .

The fact article will very likely be an interesting exercise in speculation by Stephen L. Gillett, Ph.D., also dealing with aliens. Chlorine or fluorine breathers used to be commoner in science fiction than they have been lately, but does current science suggest ways they—or something like them—might actually exist?

IN TIMES TO COME

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the reference library

By Tom Easton

Heretics of Dune, Frank Herbert, Putnam, $16.95, 464 pp.
Pet Sematary, Stephen King, Doubleday, $15.95, 374 pp.
Across the Sea of Suns, Gregory Benford, Timescape, $15.95, 399 pp.
Tales of the Velvet Comet #2: Eros at Zenith, Mike Resnick, Phantasia, $17 (trade), $35 (collector's), ?pp., Signet, $?, ?pp.
Damiano's Lute, R. A. MacAvoy, Bantam, $2.75, 272 pp.
The Sentinel, Arthur C. Clarke, Berkley, $6.95, 303 pp.
1984: Spring—A Choice of Futures, Arthur C. Clarke, Ballantine/Del Rey, $14.95, 256 pp.
Dr. Adder, K. W. Jeter, Bluejay, $7.95 (trade pb), $32.00 (collector's), 240 pp.
Angado: Dumarest of Terra #29, E. C. Tubb, DAW, $2.50, 159 pp.
Salvage and Destroy, Edward Llewellyn, DAW, $2.95, 256 pp.
The Mutants Are Coming, Isidore Haiblum, Doubleday, $11.95, 192 pp.
Over My Shoulder: Reflections on a Science Fiction Era, Lloyd Arthur Eshbach, Oswald Train: Publisher (P.O. Box 1891, Philadelphia, PA 19105), $20.00, 417 pp.
Future Life, Michel Salomon, Macmillan, $19.95, 384 pp. (**L'Avenir de la Vie**, Edition Seghers, Paris, 1981).

Frank Herbert is one fortunate writer. He has a long list of books to his credit and most of them have succeeded well enough to make him a prosperous fellow. But in 1965 he came up with *Dune*, and that one made him wealthy. The readers loved it. I loved it.

So he wrote *Dune Messiah* and *Children of Dune* and *God Emperor of Dune*, and the readers loved them too. I liked the first two, but not the last. It was too much monomania, exhausting in its obsessions, and not much of a yarn.

So now he's written **Heretics of Dune**, and I find it better than *God Em-*

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peror, if not quite up to the earlier books. It's still monomaniacal, but it's about heresy, which draws us away from Muad'dib and Leto II, millennia in the story's past.

On Arrakis, now Bakis, has appeared a young girl who can control the sandworms that carry fragments of the God Emperor's consciousness. On another world, the Bene Gesserit are rearing another Duncan Idaho ghola with which they hope to seize Bakis and what remains of the natural spice trade. Civilization is quaking under the onslaught of peoples returning from the vast stretches of the galaxy beyond the settled stars, bringing variant philosophies and Reverend Mothers. The Bene Tleilax intrigue for mastery, and in the process prepare the Idaho ghola to be something more than usual.

It all comes together with the sweeping inevitability of histories clashing. Herbert's story feels far more real than *God Emperor*, and if it lacks the personal tone of the early Dunes, it more than makes up for the lack with a stateliness born of a vivid sense of the millennia. Yet there is a personal side to the story. There are vivid, living characters. There is vigorous adventure and climax and resolution. And with it all, Herbert continues to amaze me with the continuity of his vision. He may even be the philosopher some of his fans claim he is.

If you're a *Dune* fan, don't miss this one. If you're not—well, Putnam is reissuing *Dune*, in hardcover, no less, to give you a chance to get hooked easily. Go ahead, buy them both, and then start haunting the used book stores for the other volumes in the series. See the movie version of *Dune*, to be released in December, and look forward to *Dune VI*.

* * *

Pet Sematary may be Steve King's best book yet. Or is it? The usual symptom of a superlative book is that "you can't put it down," but I found it all too easy to put this one down, sometimes after only a chapter or two. This wasn't because the book failed to hold and grip. Rather, it was because King gives us a story of a very nice couple, Dr. Louis Creed and his wife Rachel, their two darling children, Ellie and Gage, and their cat, Winston "Church" Churchill, a family so nice and so normal that I for one did *not* want to find out what awful thing would happen to them next.

And I knew that worse was always to come. *Pet Sematary* starts out as a soft, gentle, loving pastoral. The Creed family has just moved from Chicago to Ludlow, Maine, not far from Orono, where Louis is the new physician for the University of Maine. Next door live Jud and Norma Crandall; Jud is a prototypical Yankee codger, a beer-drinking octogenarian. Behind the house lie woods, and a path leading to the Pet Sematary, where generations of Ludlow children have buried their pets, marking their graves with a miniature Stonehenge of flattened tin cans and old shingles. Beyond the Pet Sematary is a blowdown of tangled tree trunks, and beyond that lies . . .

A student dies, and his ghost returns to warn the doctor about that mystery in the deeper forest. Church is hit by a car, and Jud shows Louis the secret, an old Indian burying ground. Louis inters the cat, and next day the cat comes back, strangely changed. And life goes on.

Nothing awful happens for the whole next year. Norma Crandall dies, but of a stroke. Nevertheless, we know that worse is coming. King makes this clear

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as can be. Even as he deftly paints the Maine climate and setting, even as he dissects the range of normal and abnormal reactions to death, grief and sadness and survivors' guilt, even as he develops characters as aptly suited for his story as any I have ever seen, he is progressing inexorably and excruciatingly toward his climax. He has the instincts of a torturer, never letting up, never promising a happy ending, endlessly drawing out the suspense, to the point where for the first half of the book the horror seems almost incidental.

Ahh, but then! Two-year-old Gage gets creamed by a truck. The thing in the woods exerts its swelling powers. And the Creeds go to hell in a hurry —though, again, King draws the process out excruciatingly.

I do not hesitate to recommend this one to anyone, except maybe to the squeamish and the faint of heart. Supposedly, King himself found this tale "so horrifying that he was for a time unwilling to finish writing it." I can see why. It's superlatively gory, superlatively suspenseful, superlatively horrifying, and superlatively well done. It deals with the occult and the supernatural, but indirectly, by implication and impact and contrast. It is not science fiction. It is purest fantasy. And it is, as we say here in Maine, *some wicked good*.

Greg Benford's **Across the Sea of Suns** is the sequel to *In the Ocean of Night*, in which Nigel Walmsley found an ancient spacecraft. Now, thirty years later, he is aboard the starship *Lancer*, off to seek the origins of mysterious signals, fragmentary messages in English. He is older than most of his shipmates, and hence his competence is suspect, but though he continues to age, failing and unregarded, he insists on taking part. He insinuates himself among the explorers of the source world to see the strange beings who play back fragments of old radio shows with built-in transmitters. He is there when a strange satellite turns out to be a mechanical ravener, and he is the first to realize that the galaxy is occupied by mechanical intelligences that brook no organic competition.

Meanwhile, back on Earth, alien Swarmers and Skimmers drive humanity from the seas and threaten civilization itself. Raft-borne from a scuttled ship, Warren learns from the Skimmers that they and the Swarmers are one species, split by disease, delivered by design to divert human efforts from space.

And finally, nuclear war breaks out on Earth. The *Lancer* is attacked and badly damaged. Nigel is marooned. The end of all has come.

Or has it? Timescape promises a third volume in the series, which should make the trilogy one of the major SF events of the decade—or more. Benford shows an impressive breadth of vision, an awesome compassion, and a striking skill with his characters—his treatment of Nigel and his two paramours is deft and sympathetic. At the same time, his skills as a writer are impressive, and when he tries to capture the sense of multiple-track conversation in multitrack prose, he succeeds admirably. I heartily recommend the book and the Benford name.

The Velvet Comet is Mike Resnick's brothel n the sky, where all good men and women can go for the weekend when they make their pile. It's luxe de luxe, most elegant of sinning, and it's exclusive.

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So much Mike told us in *Eros Ascending*, when he played off romanticism and reality, with the latter winning. In **Eros at Zenith**, it's romanticism of another sort, and this time the table turns. There has been a murder on the Comet. To solve it, the Vainmill Syndicate sends ace detective Andrew Jackson Crane, an ambitious and abrasive young man. Crane quickly solves the mystery, traps a mass murderer, and confronts Mike's chosen issue.

Mike phrases the issue explicitly as Order versus Eros, as the triviality of murder versus the significance of whoredom. But beneath that is his apparent belief that the most worthy of people have some firm sense of commitment or dedication, a love of something beyond self. Of his characters, the greatest self-lovers—the outright villains—lose all. Crane loses edge and firmness. Only the Comet's madam, the Black Pearl, emerges unsullied.

Eros at Zenith is another of Mike's patent fables. Unfortunately, he's done better, even in *Eros Ascending* (about which I had reservations). The problem is that here there is too much half-witty banter and too little action, and the dice are loaded. The fable becomes far too explicit, and the tale palls well before the end. Yet the tale does move right along, and Crane is a character who begs for another story or two. Bring him back, Mike. Give him a short story, at least, or another novel or two. Grow him up.

R. A. MacAvoy continues to be one of the best new fantasy writers in years. *Tea with the Black Dragon* was an event. So was *Damiano*, the tale of an Italian Renaissance wizard who takes lute lessons from the archangel Raphael, meets the Devil, defeats a military evil, surrenders his sorcerous powers and soul to a Finnish witch, Saara, and sets out on a trek to realize his musical destiny.

In **Damiano's Lute**, Damiano finds success. Despite a harrowing encounter with the Black Death, he reaches Avignon to play before Pope Innocent II and receive the gift of a marvelous lute. However, the side-plot, the search for his sidekick Gaspare's harlot sister, becomes dominant. It leads Damiano to become Saara's lover and resume his powers, reveals an abortive conflict of expectations, and tells us why the third volume of the trilogy, *Raphael*, will concern the angel who is becoming more human.

Don't pass this one up. MacEvoy is a charming, evocative, warm writer, full of love and life and vision. She offers us a rare gift of pleasure, which we should not refuse.

The Sentinel is the first of Byron Preiss's "Masterworks of Science Fiction and Fantasy," and it promises well for the series. Evocatively illustrated by architect Lebbeus Woods, it offers nine stories, "Rescue Party" (1946), "Guardian Angel" (1950), which became *Childhood's End*, "Breaking Strain" (1949), "The Sentinel" (1951), which evolved into *2001: A Space Odyssey*, "Jupiter V" (1953), "Refugee" (1955), "The Wind from the Sea" (1963), "A Meeting with Medusa" (1972), and "The Songs of Distant Earth" (1979). All are skillful. Some are prophetic. Together, they display the evolution of a master and serve, as intended, to introduce the new reader to Arthur C. Clarke.

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In **1984: Spring—A Choice of Futures**, Clarke offers a sampling of his nonfiction, including the introduction to *The Sentinel* (which also appeared in the March 6, 1983 *New York Times Book Review*). Some of the other pieces date back to the '40s and '50s. Most are more recent, and they include addresses before UN bodies and addresses of the Chancellor to convocations at the University of Moratuwa in Colombo, Sri Lanka.

Clarke comes across as a serene technological optimist who, when necessary, can eat crow most gracefully; compare "The Eve of Apollo" and "Apollo Plus Ten." Perhaps, he makes us wonder, it is the fate of optimists to *have* to eat crow now and then. Yet optimists can also learn from their diet. Clarke seems a less reckless prognosticator today, focusing more on the likelier prospects of the communications revolution than the aborted (for now) colonization of the moon.

Together, the two books are a thorough overview of Arthur C. Clarke. Buy both. Use them to acquaint your nonfan friends with SF and its people at their best.

In 1972, a college student named K. W. Jeter produced a manuscript his prof thought was good. On the prof's word, Philip K. Dick read it and thought it a masterpiece, the sort of work that could set the SF world on its ear and redefine SF itself.

But no one would publish **Dr. Adder**. Its portrayal of a morally bankrupt future, where prostitutes were surgically altered to satisfy bizarre fantasies, was just too much. Even the opening scene—a ranch where genetically engineered chickens lay eggs so big only a forklift can carry them and, in their spare time, lay the ranch employees as well—was too much. The universal reaction, I'm sure, was not "Obscene!" but "Gross!"

Dick tried to help. Some time before he died, he gave Jeter a very complimentary afterword that praised whatever "courageous publisher" might eventually buy the book. That publisher turned out to be Jim Frenkel and his Bluejay Books, who will surely not lose money on the deal. *Dr. Adder is* gross, and obscene, and outrageous, but it is also a very Dickian yarn. It lacks vivid characters, but its bizarre social setting is well realized and the action moves quickly. E. Allen Limmit leaves the chicken ranch for Los Angeles, bearing a deadly gift for Dr. Adder, the harlots' surgeon. When Adder's aide is assassinated, Limmit steps into the position, only to be cast adrift in the slums when Adder's arch-foe, the video evangelist John Mox, wipes out Adder and his empire. Limmit then encounters the Society for the Prodigal Son—Orange County fathers seeking children lost to LA sin—an alien visitor, a N*E*W Disneyland, revolution, and more.

Will the book really have any lasting impact? I doubt it. It's good enough as a story. But its world is too outré to make Jetter's vision applicable to the real future in any significant way. No one can read *Dr. Adder* and think "This could happen."

Nor will the book have much impact on style or plotting, for its own are quite familiar in form. Whatever impact it has will be due to its great strength, the bizarreness that gives it the appeal of a sideshow (consider the delightful source of the enmity between Adder and Mox in what the former did, on request, yet, to the latter's wife!). But this bizarre-

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ness is ultimately trivial, even though it is what kept the book off the market for so long and even though it may be what impressed Dick so much. It may impress you, too.

The book is not a literary event. It is no more than a literary curiosity, worth reading because Jeter handles his material deftly and—insofar as it is possible—with taste. But like J. F. Carr's recent work (*Pontifex Mardi Gras*), it represents an extreme vision—California as Sodom and Gomorrah—that I, from the quiet stability of Maine, suspect of provincialism. The cities are going to hell in a handbasket, but neither all nor wholly, and the American culture will survive the next century much as it has the last. There is change, yes, but the basic pattern remains much the same.

With **Angado**, Dumarest is once more close to finding the way to Terra! He has fled a circus, leaving the Cyclan to think him dead, acquired a remittance-man companion, Angado, survived near-death in the arena, and reached Angado's world of Lychen. There he hopes to find a man with old star maps, but. . . . The Cyclan arrives, and Dumarest escapes by the skin of his teeth.

Number 30 just may give Dumarest the coordinates he seeks. Will it end the series? Surely not, but that end *may* be near! Something is going wrong in the very heart of the Cyclan. Madness is growing in Central Intelligence, that vault of disembodied brains that rules the Cyclan, and the rapport by which the Cyclan's Cyber agents report is suddenly flawed.

So let me venture a tentative prediction. Tubb will finally let the Cyclan catch Dumarest. Our hero will be trapped. There will be no way out. Interrogation will be imminent, and the Cyclan will be just about to gain the key to galactic domination. And then the Cyclan itself will collapse. It will die of the rot within. Dumarest will at last be free. And Tubb will leave him. He will never find Terra again, but perhaps he will be able to settle down with one of his many loves.

According to Edward Llewellyn's **Salvage and Destroy**, millennia ago, the Ults defeated an enemy, the Drin, and established a realm of peace among the stars. The Ults have immortality, but to gain it, the individual must forego sexual maturity; the Ult rulers are children in body, and, in some ways, in mind as well. The Drin had immortality of another sort, gained by shifting their minds into the bodies of subject races once they had bred in their own; the shifted Drin can breed, but the Drin mentality fades with generations of dilution by their hosts' genes (I don't quite see how it works, but let Llewellyn have his plot device).

In the year 1680 A.D., an Ult expedition found Earth and brought back a number of humans, who multiplied, prospered, and became the main starfarers of the Ult realm. Come the present, the Ults pick up signals from Earth that scare them, and they decide to send a mission to examine the planet and its denizens and destroy a beacon set nearby, so humans cannot bring their aggressiveness down on the Ults. Ult Lucian leads the mission, and to do so he adjusts his body to seem more human.

As we might expect, Lucian finds that being human is very different from being Ult. Humans are fresh, bold, clever, and independent, and he finds

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that he actually prefers humanity. Guided by the inherited personalities of three ancestors and goaded by the ghost in the machine—an electronic replica of a 1680 woman stored in his ship's computer—he defeats lingering Drin menaces and brings the mission to an unforeseen success. The novel's end is satisfying and promising, but Llewellyn takes a long time getting there. He is at times excessively talky, and *Salvage and Destroy* seems both less vigorous and less intriguing than Llewellyn's earlier DAW novels.

Isidore Haiblum's past books have been antically preposterous. **The Mutants Are Coming** is more straightforward. It is even nearly believable, once you get past the blurb that says subliminal education can turn you into a mutant.

The story's mutants are hangovers of a past nuclear war. The subliminal education is a banned tool of mass communications and control that would-be dictators are preparing to exploit. The story itself is the search of Moon Base's ambassador, Jim Morgan, for Senator Fulton. Moon Base is worried. It is not in favor, and the man who looks like the next U.S. dictator, Raymond Hess, has vowed to close the Base down. Fulton supports the Base, and Morgan's job is to help him stymie Hess. Yet Fulton has vanished.

His search leads Morgan to the mutants, puts him in the middle of several simultaneous uprisings and attempted coups, and finally shows him Fulton. He is abused by goons and deceived by friend and foe. In the end, Moon Base seems secure and the U.S. peaceful, for the time being. And Morgan has something to pass for true love.

But though Haiblum is a facile writer, he induces very little suspension of disbelief. Both premises and people remain preposterous.

Lloyd Eshbach has been a writer of SF beginning in 1929, a fan, a book collector, and a publisher, running one of the small presses that once filled the needs of fans for SF books. Most recently, he has completed E. E. "Doc" Smith's unfinished novel, *Subspace Encounter*.

Over My Shoulder is in part Eshbach's autobiography. It is also a personal memoir of the small press era. It shows the yearnings that led many fans to become publishers, of single books or whole lines, usually on very short shoestrings. It provides what Eshbach says are the true versions of several stories. It casts light in hidden, forgotten corners.

And it's pretty readable. Eshbach takes a loose, chatty approach to his topic. He is almost gossiping, and his tone seems to fit, for he is dealing often in the gossip of fandom. A more academic treatment, while possible, would be far less congenial.

And don't miss Algis Budrys's introduction, in which he *almost* says that SF is a religion.

Michel Salomon's **Future Life** is a collection of eighteen interviews with distinguished scientists of the U.S. and Europe, including six Nobel winners. Those originally conducted in English were not translated for this book; the rest were skillfully translated from French by Guy Daniels. The scientists included are André Cournand, Robert Good, Roy Vagelos, Konrad Lorenz, Christian de Duve, René Dubos, Erwin Chargaff,

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André Lwoff, Gabriel Nahas, Floyd Bloom, Henri Laboret, Jacques Attali, Elie Shneour, Jonas Salk, José Delgado, Hans Krebs, Niko Tinbergen, and Jean Bernard. All are biologists and/or physicians at the tops of their fields, so restricted presumably because Salomon himself is a physican and editor of the French journal *Prospective et Santé (Futurism and Health)*.

The interviews follow a fairly set pattern, for Salomon approached each of his subjects with a list of twenty questions probing prospects for medical treatment and bioengineering, and the difference between utopian and realistic visions of the future. He was seeking the SF in scientific reality, and at times he found it. He also found complete rejection of the marvelous, as in the marvelously pessimistic Chargaff. Others gave him everything from tabloid sensationalism to solid, down-to-earth hopes and dreams.

One problem with the book is that recent progress has made it already dated in some ways. Another problem is that the interviews were apparently transcribed from tape by someone who was not very familiar with medical or biological terminology. Salomon should have caught and corrected such gaffes as "arithroblastosis fatalis." Yet though the book occasionally assaults the eye, it remains an intriguing compendium of glances toward the future, enriched by the author's thumbnail sketches of his subjects.

Buy the book, and learn what the experts see for cancer, immunology, life extension, brain control, euthanasia, and more. ■

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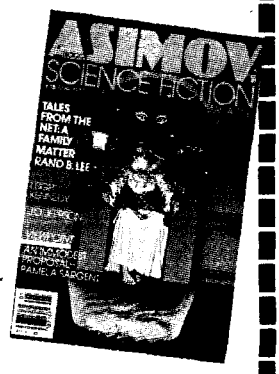

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a calendar of analog upcoming events

10 - 12 August
PARACON VII (Central Pennsylvania SF conference) at Sheraton Penn State, State College, Penna. Guest of Honor—Marvin Kaye, Fan Guest of Honor—Peggy Rae Pavlat. Registration—$11 until 15 July, $14 thereafter. Info: Paracon VII, Box 1156, State College PA 16801.

10 - 13 August
MYTHCON XV (Mythopoeic-oriented conference) at Mills College, Oakland, Calif. Guest of Honor—Jane Yolen, Deceased Guest of Honor—George MacDonald. Theme—"The Wood Between the Worlds." Room and board $120 (Feast not included). Info: Mythcon XV, 6017 Avila Ave., El Cerrito CA 94530.

30 August - 3 September
LA CON II (42nd World Science Fiction Convention) at Anaheim Convention Center, Los Angeles, Calif. Guest of Honor—Gordon R. Dickson, Fan Guest of Honor—Dick Eney, TMs—Robert Bloch & Jerry Pournelle. Registration—$50 until 15 July 1984, $75 at the door. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: LA Con II, Box 8442, Van Nuys CA 91409.

7 - 9 September
EARTHCON 4 (Multi-media SF conference) in Cleveland, Ohio. Gaming, Star Trek festival, video. Info: Earthcon 4, Box 5641, Cleveland OH 44101.

10 - 12 September
Second International Conference on Computer Security (IFIP) at Toronto, Ontario, Canada. Info: IFIP/SEC 84, Suite 1806, 2 Carlton Street, Toronto, Ontario, Canada M5B 1J3.

16 - 20 September
CompCom Fall 84, Small Computer (R)Evolution at Arlington, Va. Info: CompCom Fall 84, Box 639, Silver Spring MD 20901. 301-589-8142. TWX 7108250437 IEEECOMPSO.

28 - 30 September
AD ASTRA IV (SF conference) at Howard Johnson's Airport Hotel, Toronto, Ontario. Guest of Honor—Dean Ing. Fan guest of Honour—Bob Passovoy. Registration—CDN$12 through Labor Day, CDN$15 at the door. Info: Ad Astra IV, Box 7276, Station A, Toronto, Ontario, Canada M5W 1X9.

8 - 10 October
ACM 1984 Annual Conference at San Francisco, Calif. Info: Karen A. Duncan, Health Information Systems, 15 Parons Way, Los Altos CA 94022. 415-948-3941.

12 - 14 October
WORLD FANTASY CONVENTION 1984 at the Westin Hotel, Ottawa, Ontario, Canada. Guest of Honour—Jane Yolen, Artist Guest of Honour—Jeff Jones, TM—Spider Robinson. Registration—$35 ($43 Canadian) attending, $12 ($15 Canadian) supporting. Info: World Fantasy Convention, P.O.Box 4911, Station E, Ottawa, Ontario, Canada K1S 5J1.

Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices six months in advance of the event.

CORRECTION:

ARCHON 8, the St. Louis area SF convention, was listed in the July *Analog* as taking place July 13-15. The convention is actually scheduled for July 27-29, 1984.

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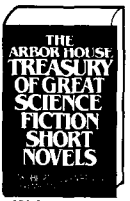

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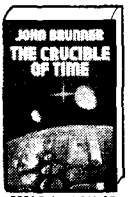

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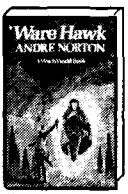

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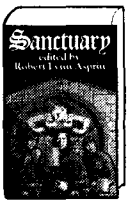

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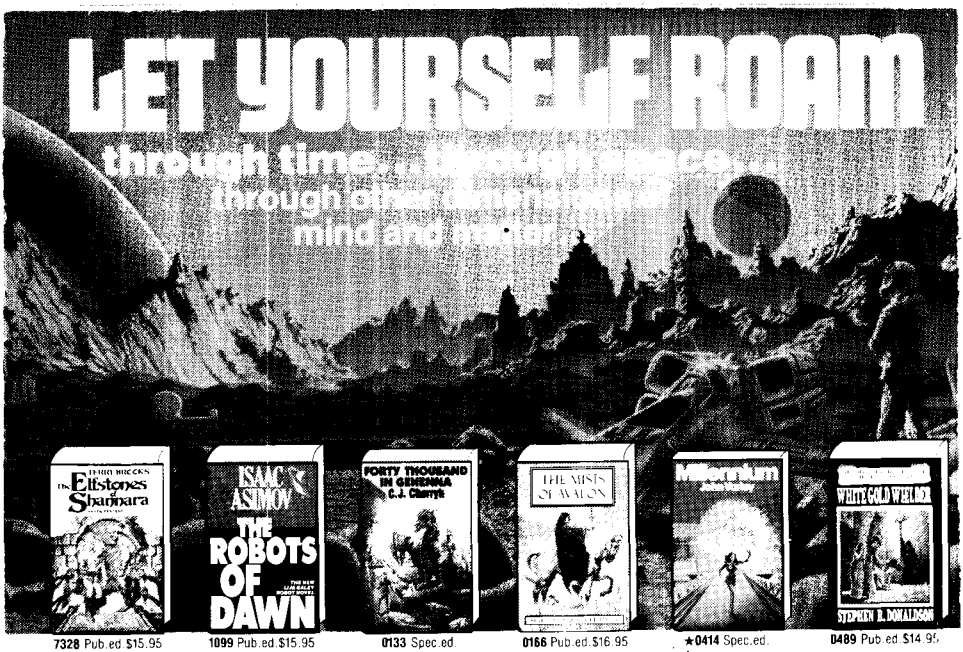

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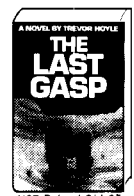

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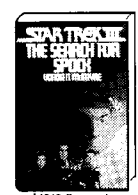

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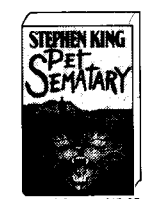

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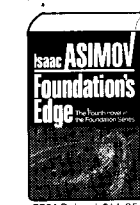

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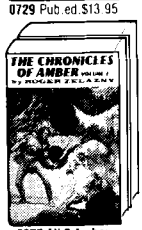

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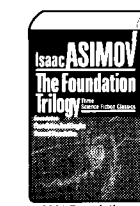

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